

## 1.5A High-Speed 30V MOSFET Drivers

### Features

- High Peak Output Current – 1.5 A
- Wide Input Supply Operating Range:
  - 4.5V to 30V
- High Capacitive Load Drive Capability:
  - 1000 pF in 25 nsec
- Short Delay Times – <78 nsec Typ.
- Low Supply Current:
  - With Logic '1' Input – 2.5 mA
  - With Logic '0' Input – 300  $\mu$ A
- Low Output Impedance – 7  $\Omega$
- Latch-Up Protected: Will Withstand >300 mA Reverse Current
- ESD Protected – 4 kV

### Applications

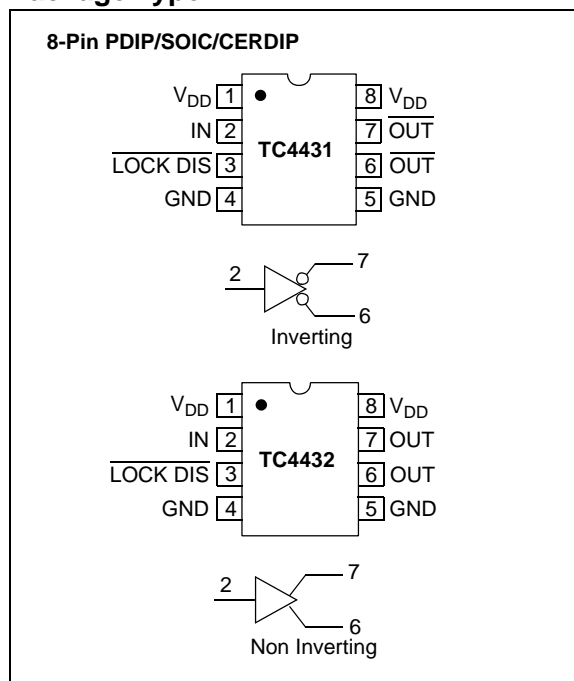
- Small Motor Drive
- Power MOSFET Driver
- Driving Bipolar Transistors

### General Description

The TC4431/TC4432 are 30V CMOS buffer/drivers suitable for use in high-side driver applications. They will not latch up under any conditions within their power and voltage ratings. They can accept, without damage or logic upset, up to 300 mA of reverse current (of either polarity) being forced back into their outputs. All terminals are fully protected against up to 4 kV of electrostatic discharge.

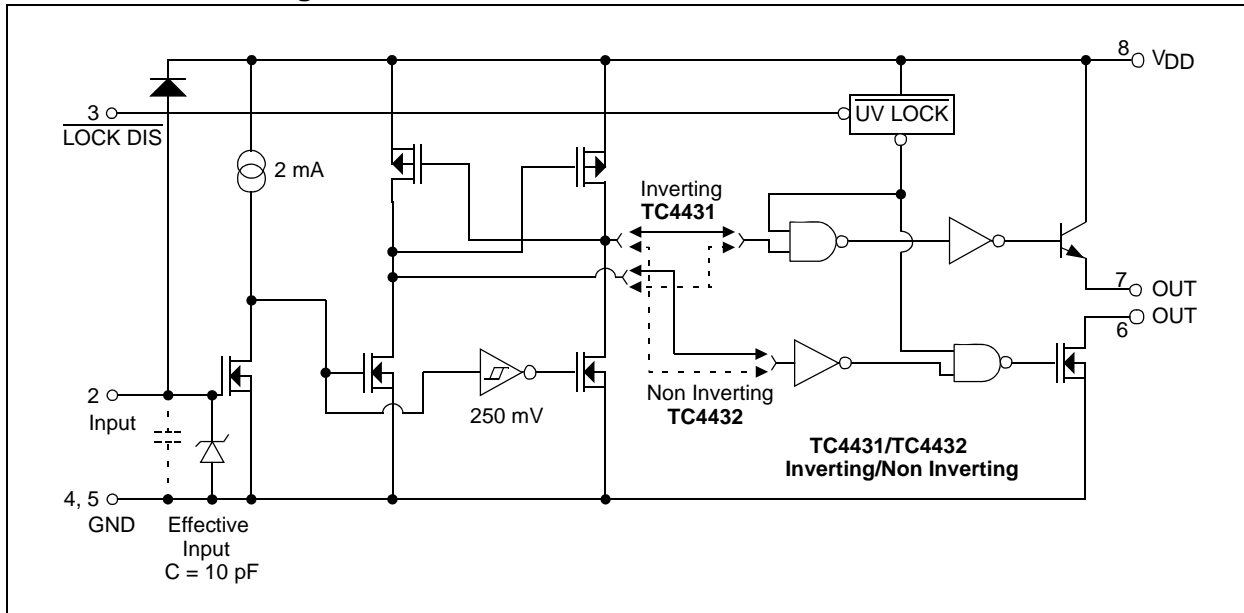
Under-voltage lockout circuitry forces the output to a 'low' state when the input supply voltage drops below 7V. For operation at lower voltages, disable the lockout and start-up circuit by grounding pin 3 (LOCK DIS); for all other situations, pin 3 (LOCK DIS) should be left floating. The under-voltage lockout and start-up circuit gives brown out protection when driving MOSFETS.

### Package Type



# TC4431/TC4432

## Functional Block Diagram



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Supply Voltage .....	36V
Input Voltage (Note 1) .....	$V_{DD} + 0.3V$ to GND
Package Power Dissipation ( $T_A \leq 70^\circ\text{C}$ )	
PDIP .....	730 mW
CERDIP .....	800 mW
SOIC .....	470 mW
Maximum Junction Temperature, $T_J$ .....	+150°C
Storage Temperature Range .....	-65°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.

### DC CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, $T_A = +25^\circ\text{C}$ with $4.5V \leq V_{DD} \leq 30V$ .						
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Input</b>						
Logic '1', High Input Voltage	$V_{IH}$	2.4	—	—	V	
Logic '0', Low Input Voltage	$V_{IL}$	—	—	0.8	V	
Input Current (Note 1)	$I_{IN}$	-1	—	1	$\mu\text{A}$	$0V \leq V_{IN} \leq 12V$
<b>Output</b>						
High Output Voltage	$V_{OH}$	$V_{DD} - 1.0$	$V_{DD} - 0.8$	—	V	$I_{OUT} = 100 \text{ mA}$
Low Output Voltage	$V_{OL}$	—	—	0.025	V	
Output Resistance	$R_O$	—	7	10	$\Omega$	$I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 30V$
Peak Output Current	$I_{PK}$	—	3.0	—	A	Source: $V_{DD} = 30V$ Sink: $V_{DD} = 30V$
Latch-Up Protection Withstand Reverse Current	$I_{REV}$	—	0.3	—	A	Duty cycle $\leq 2\%$ , $t \leq 300 \mu\text{sec}$
<b>Switching Time (Note 2)</b>						
Rise Time	$t_R$	—	25	40	ns	Figure 4-1
Fall Time	$t_F$	—	33	50	ns	Figure 4-1
Delay Time	$t_{D1}$	—	62	80	ns	Figure 4-1
Delay Time	$t_{D2}$	—	78	90	ns	Figure 4-1
<b>Power Supply</b>						
Power Supply Current	$I_S$	—	2.5	4	mA	$V_{IN} = 3V$ $V_{IN} = 0V$
Start-up Threshold	$V_S$	—	8.4	10	V	
Drop-out Threshold	$V_{DO}$	7	7.7	—	V	Note 3

**Note 1:** For inputs >12V, add a 1 k $\Omega$  resistor in series with the input. See Section 2.0 "Typical Performance Curves" for input current graph.

**2:** Switching times are ensured by design.

**3:** For operation below 7V, pin 3 (LOCK DIS) should be tied to ground to disable the lockout and start-up circuit, otherwise, pin 3 **must** be left floating.

# TC4431/TC4432

## DC CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, Over operating temperature range with $4.5V \leq V_{DD} \leq 30V$ .						
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Input</b>						
Logic '1', High Input Voltage	$V_{IH}$	2.4	—	—	V	
Logic '0', Low Input Voltage	$V_{IL}$	—	—	0.8	V	
Input Current ( <b>Note 1</b> )	$I_{IN}$	-10	—	10	$\mu A$	$0V \leq V_{IN} \leq 12V$
<b>Output</b>						
High Output Voltage	$V_{OH}$	$V_{DD} - 1.2$	—	—	V	$I_{OUT} = 100 \text{ mA}$
Low Output Voltage	$V_{OL}$	—	—	0.025	V	
Output Resistance	$R_O$	—	—	12	$\Omega$	$I_{OUT} = 10 \text{ mA}, V_{DD} = 30V$
<b>Switching Time (Note 2)</b>						
Rise Time	$t_R$	—	—	60	ns	Figure 4-1
Fall Time	$t_F$	—	—	70	ns	Figure 4-1
Delay Time	$t_{D1}$	—	—	100	ns	Figure 4-1
Delay Time	$t_{D2}$	—	—	110	ns	Figure 4-1
<b>Power Supply</b>						
Power Supply Current	$I_S$	—	—	6 0.7	mA	$V_{IN} = 3V$ $V_{IN} = 0V$
Start-up Threshold	$V_S$	—	8.4	10	V	
Drop-out Threshold	$V_{DO}$	7	7.7	—	V	<b>Note 3</b>

**Note 1:** For inputs >12V, add a 1 k $\Omega$  resistor in series with the input. See **Section 2.0 "Typical Performance Curves"** for input current graph.

**2:** Switching times are ensured by design.

**3:** For operation below 7V, pin 3 ( $\overline{\text{LOCK DIS}}$ ) should be tied to ground to disable the lockout and start-up circuit, otherwise, pin 3 **must** be left floating.

## TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, all parameters apply with $4.5V \leq V_{DD} \leq 30V$ .						
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Temperature Ranges</b>						
Specified Temperature Range (C)	$T_A$	0	—	+70	$^{\circ}C$	
Specified Temperature Range (E)	$T_A$	-40	—	+85	$^{\circ}C$	
Specified Temperature Range (V)	$T_A$	-40	—	+125	$^{\circ}C$	
Maximum Junction Temperature	$T_J$	—	—	+150	$^{\circ}C$	
Storage Temperature Range	$T_A$	-65	—	+150	$^{\circ}C$	
<b>Package Thermal Resistances:</b>						
Thermal Resistance, 8L-SOIC	$\theta_{JA}$	—	155	—	$^{\circ}C/W$	
Thermal Resistance, 8L-PDIP	$\theta_{JA}$	—	125	—	$^{\circ}C/W$	
Thermal Resistance, 8L-CERDIP	$\theta_{JA}$	—	150	—	$^{\circ}C/W$	

## 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,  $T_A = +25^\circ\text{C}$  with  $4.5\text{V} \leq V_{DD} \leq 30\text{V}$ .



**FIGURE 2-1:** Supply Current vs. Capacitive Load.



**FIGURE 2-3:** Rise/Fall Time vs.  $V_{DD}$ .



**FIGURE 2-2:** Input Current vs. Input Voltage.



**FIGURE 2-4:**  $t_{D1}$  and  $t_{D2}$  Delay vs.  $V_{DD}$ .

# TC4431/TC4432

## 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	$V_{DD}$	Supply Input, 4.5V to 30V
2	IN	TTL/CMOS Compatible Input
3	$\overline{\text{LOCK DIS}}$	Input Pin, Enable/Disable for UV Lockout
4	GND	Ground
5	GND	Ground
6	OUT	Drive Output, Pull Down
7	OUT	Drive Output, Pull Up
8	$V_{DD}$	Supply Input, 4.5V to 30V

### 3.1 Supply Input ( $V_{DD}$ )

The  $V_{DD}$  input is the bias supply input for the MOSFET driver and is rated for 4.5V to 30V with respect to the ground pins. The  $V_{DD}$  input should be bypassed to ground with a local ceramic capacitor. The value of this capacitor should be chosen based on the capacitive load that is being driven.

### 3.2 Control Input (IN)

The MOSFET driver input is a TTL/CMOS compatible input with 250 mV of hysteresis between the high and low threshold voltages. If an input signal level of greater than 12V is applied to the device, a series current limiting resistor is recommended.

### 3.3 Lockout Disable ( $\overline{\text{LOCK DIS}}$ )

The lockout pin enables/disables the undervoltage lockout feature of the device. If undervoltage lockout is desired (output is not enabled until the bias voltage reaches 8.4V (typical) on the rising edge and is disabled when the bias voltage reaches 7.7V (typical) on the falling edge), the lockout pin should be left floating. If operation below 7V is desired, the lockout pin should be tied to ground.

### 3.4 Ground (GND)

The ground pins are the return path for the bias current and for the high peak currents which discharge the load capacitor. Both ground pins should be used to ensure proper operation. The ground pins should be tied into a ground plane or have short traces to the bias supply source return.

### 3.5 Drive Output (OUT)

The TC4431/TC4432 devices have individual source and sink output pins. This feature can be used to adjust the rise and fall time independently by adding separate charge and discharge resistors external to the device. Pin 7 (source output) can source 3 A peak currents into capacitive loads and pin 6 (sink output) can sink 1.5 A peak currents from a capacitive load.

## 4.0 APPLICATIONS INFORMATION



**FIGURE 4-1:** Switching Time Test Circuit.

# TC4431/TC4432

## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

8-Lead CERDIP (300 mil)



Example:



8-Lead PDIP (300 mil)



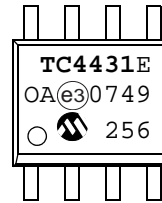
Example:



8-Lead SOIC (150 mil)



Example:



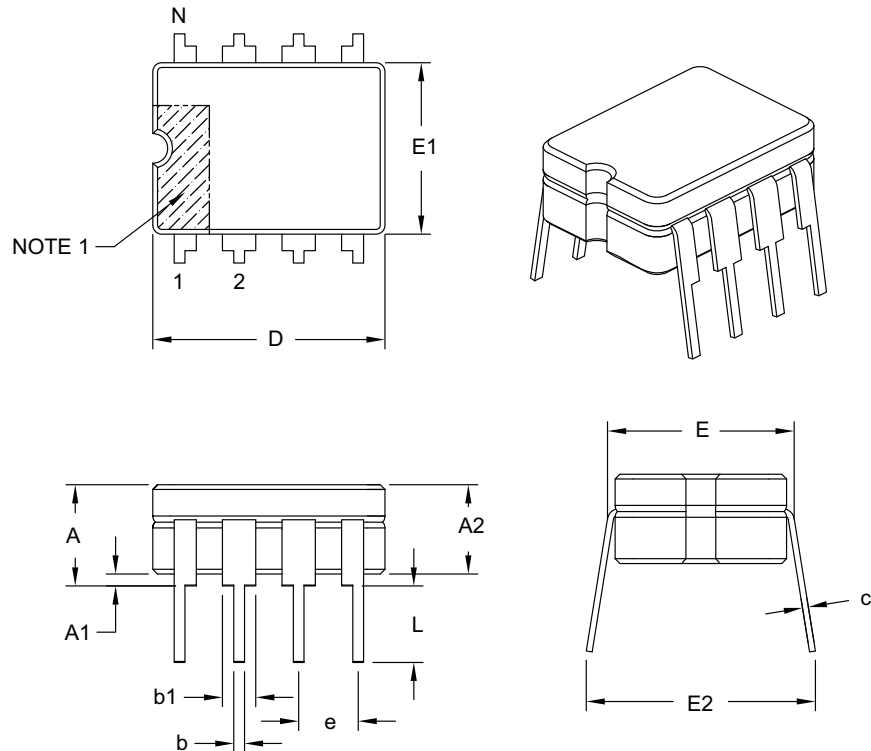
<b>Legend:</b>	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free.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



## 8-Lead Ceramic Dual In-Line (JA) – .300" Body [CERDIP]

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



Dimension Limits	Units	INCHES		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	.100 BSC		
Top to Seating Plane	A	–	–	.200
Standoff §	A1	.015	–	–
Ceramic Package Height	A2	.140	–	.175
Shoulder to Shoulder Width	E	.290	–	.320
Ceramic Package Width	E1	.230	.248	.300
Overall Length	D	.370	.380	.400
Tip to Seating Plane	L	.125	–	.200
Lead Thickness	c	.008	–	.015
Upper Lead Width	b1	.045	–	.065
Lower Lead Width	b	.015	–	.023
Overall Row Spacing	E2	.314	–	.410

**Notes:**

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic.
- Dimensioning and tolerancing per ASME Y14.5M.  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-001B

# TC4431/TC4432

## 8-Lead Plastic Dual In-Line (P) – 300 mil Body [PDIP]

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



Dimension Limits	Units	INCHES		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	.100 BSC		
Top to Seating Plane	A	–	–	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	–	–
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	–	–	.430

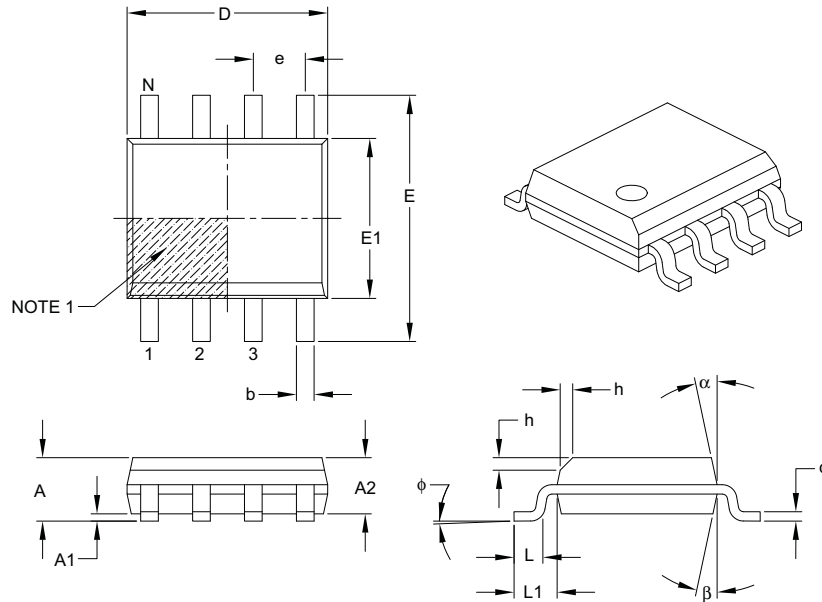
**Notes:**

- Pin 1 visual index feature may vary, but must be located with the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M.  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-018B

## 8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]

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



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	–
Standoff §	A1	0.10	–	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1	1.04 REF		
Foot Angle	$\phi$	0°	–	8°
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	$\alpha$	5°	–	15°
Mold Draft Angle Bottom	$\beta$	5°	–	15°

**Notes:**

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic.
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M.  
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.  
 REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-057B

# TC4431/TC4432

## 8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]

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



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2057A

## APPENDIX A: REVISION HISTORY

### Revision D (December 2007)

The following is the list of modifications:

1. **Section 1.0 “Electrical Characteristics”:**  
Added V temperature information to Temperature Characteristics table.
2. Added Revision History.
3. Added V temperature range to Product identification System page.

### Revision C (May 2003)

The following is the list of modifications:

1. Undocumented changes

### Revision B (May 2002)

The following is the list of modifications:

1. Undocumented changes

### Revision A (April 2002)

- Original Release of this Document.

# TC4431/TC4432

---

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>	<u>X</u>	<u>/XX</u>	<b>Examples:</b>
Device	Temperature Range	Package	
Device:	TC4431:	1.5A High-Speed 30V MOSFET Driver, Inverting	a) TC4431COA: 1.5A MOSFET driver, SOIC package, 0°C to +70°C.
	TC4432:	1.5A High-Speed 30V MOSFET Driver, Non Inverting	b) TC4431EJA: 1.5A MOSFET driver, CERDIP package, -40°C to +85°C.
Temperature Range:	C =	0°C to +70°C	c) TC4431VPA: 1.5A MOSFET driver, PDIP package, -40°C to +125°C.
	E =	-40°C to +85°C	a) TC4432CPA: 1.5A MOSFET driver, PDIP package, 0°C to +70°C.
	V =	-40°C to +125°C	b) TC4432EPA: 1.5A MOSFET driver, PDIP package, -40°C to +85°C.
Package:	JA =	Ceramic Dual In-line (300 mil Body), 8-lead *	c) TC4432VOA713: Tape and Reel, 1.5A MOSFET driver, SOIC package, -40°C to +125°C.
	OA =	Plastic SOIC, (150 mil Body), 8-lead	
	OA713 =	Plastic SOIC, (150 mil Body), 8-lead (Tape and Reel)	
	PA =	Plastic DIP (300 mil Body), 8-lead* *	
	* Offered in E-temp range only.		
	** The only package offered in the V temp range.		

# TC4431/TC4432

---

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, Accuron, dsPIC, KEELOQ, KEELOQ logo, microID, MPLAB, PIC, PICmicro, PICSTART, PRO MATE, rPIC and SmartShunt are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


AmpLab, FilterLab, Linear Active Thermistor, Migratable Memory, MXDEV, MXLAB, SEEVAL, SmartSensor and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, PICkit, PICDEM, PICDEM.net, PICLAB, PICtail, PowerCal, PowerInfo, PowerMate, PowerTool, REAL ICE, rLAB, Select Mode, Smart Serial, SmartTel, Total Endurance, UNI/O, WiperLock 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.

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

© 2007, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

**QUALITY MANAGEMENT SYSTEM**  
**CERTIFIED BY DNV**  
**== ISO/TS 16949:2002 ==**

*Microchip received ISO/TS-16949:2002 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® MCUs and dsPIC® DSCs, KEELOQ® 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.*



---

---

## 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://support.microchip.com>  
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

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

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

**Kokomo**  
Kokomo, IN  
Tel: 765-864-8360  
Fax: 765-864-8387

**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: 86-10-8528-2100  
Fax: 86-10-8528-2104

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

**China - Fuzhou**  
Tel: 86-591-8750-3506  
Fax: 86-591-8750-3521

**China - Hong Kong SAR**  
Tel: 852-2401-1200  
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: 86-755-8203-2660  
Fax: 86-755-8203-1760

**China - Shunde**  
Tel: 86-757-2839-5507  
Fax: 86-757-2839-5571

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

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

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-4182-8400  
Fax: 91-80-4182-8422

**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 - Yokohama**  
Tel: 81-45-471- 6166  
Fax: 81-45-471-6122

**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: 886-3-572-9526  
Fax: 886-3-572-6459

**Taiwan - Kaohsiung**  
Tel: 886-7-536-4818  
Fax: 886-7-536-4803

**Taiwan - Taipei**  
Tel: 886-2-2500-6610  
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

10/05/07