TC4431/TC4432

1.5A High-Speed 30V MOSFET Drivers

Features

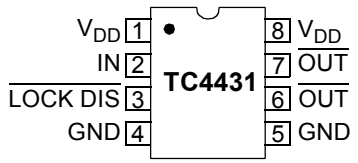
- High Peak Output Current – 1.5A
- Wide Input Supply Voltage Operating Range:
  - 4.5V to 30V
- High Capacitive Load Drive Capability:
  - 1000 pF in 25 nsec
- Short Delay Times – <78 nsec Typ.
- Low Supply Current:
  - With Logic '1' Input – 2.5 mA
  - With Logic '0' Input – 300 µA
- Low Output Impedance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

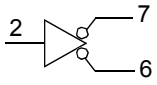
Applications

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

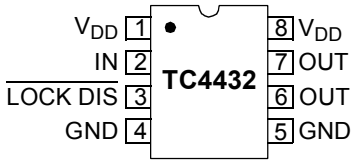
Package Types

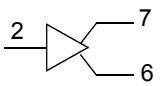
8-Pin PDIP/SOIC/CERDIP





Inverting





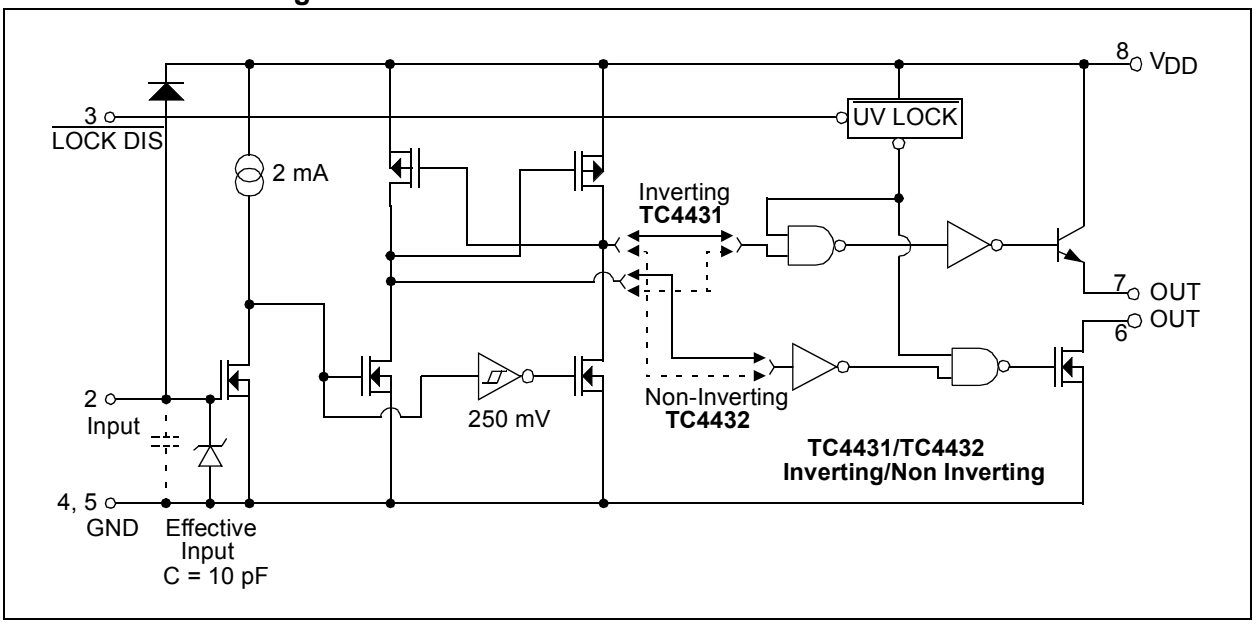
Non Inverting

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.

Undervoltage 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 should be left floating. The under-voltage lockout and start-up circuit gives brown-out protection when driving MOSFETS.

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 ($T_A \leq 70°C$)
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 = +25ºC with 4.5V $\leq V_{DD} \leq$ 30V.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Input						
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	µA	$0V \leq V_{IN} \leq 12V$
Output						
High Output Voltage	V_{OH}	V_{DD} – 1.0	V_{DD} – 0.8	—	V	I_{OUT} = 100 mA
Low Output Voltage	V_{OL}	—	—	0.025	V	
Output Resistance	R_O	—	7	10	Ω	I_{OUT} = 10 mA, V_{DD} = 30V
Peak Output Current	I_{PK}	— —	3.0 1.5	— —	A	Source: V_{DD} = 30V Sink: V_{DD} = 30V
Latch-Up Protection Withstand Reverse Current	I_{REV}	—	0.3	—	A	Duty cycle ≤ 2%, t ≤ 300 µsec
Switching Time (Note 2)						
Rise Time	t_R	—	25	40	nsec	**Figure 4-1**
Fall Time	t_F	—	33	50	nsec	**Figure 4-1**
Delay Time	t_{D1}	—	62	80	nsec	**Figure 4-1**
Delay Time	t_{D2}	—	78	90	nsec	**Figure 4-1**
Power Supply						
Power Supply Current	I_S	— —	2.5 0.3	4 0.4	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 kΩ resistor in series with the input. See "Typical Characteristics" graph for input current.

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.

DC CHARACTERISTICS (Continued)

Electrical Specifications: Unless otherwise noted, Over operating temperature range with 4.5V ≤ V_{DD} ≤ 30V.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Input						
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}	-10	—	10	µA	0V ≤ V_{IN} ≤ 12V
Output						
High Output Voltage	V_{OH}	V_{DD} – 1.2	—	—	V	I_{OUT} = 100 mA
Low Output Voltage	V_{OL}	—	—	0.025	V	
Output Resistance	R_O	—	—	12	Ω	I_{OUT} = 10 mA, V_{DD} = 30V
Switching Time (Note 2)						
Rise Time	t_R	—	—	60	nsec	**Figure 4-1**
Fall Time	t_F	—	—	70	nsec	**Figure 4-1**
Delay Time	t_{D1}	—	—	100	nsec	**Figure 4-1**
Delay Time	t_{D2}	—	—	110	nsec	**Figure 4-1**
Power Supply						
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	**Note 3**

Note 1: For inputs >12V, add a 1 kΩ resistor in series with the input. See "Typical Characteristics" graph for input current.

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 ≤ V_{DD} ≤ 30V.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Temperature Ranges						
Specified Temperature Range (C)	T_A	0	—	+70	ºC	
Specified Temperature Range (E)	T_A	-40	—	+85	ºC	
Maximum Junction Temperature	T_J	—	—	+150	ºC	
Storage Temperature Range	T_A	-65	—	+150	ºC	
Package Thermal Resistances						
Thermal Resistance, 8L-SOIC	θ_{JA}	—	155	—	ºC/W	
Thermal Resistance, 8L-PDIP	θ_{JA}	—	125	—	ºC/W	
Thermal Resistance, 8L-CERDIP	θ_{JA}	—	150	—	ºC/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 = +25ºC with 4.5V $\leq V_{DD} \leq$ 30V.

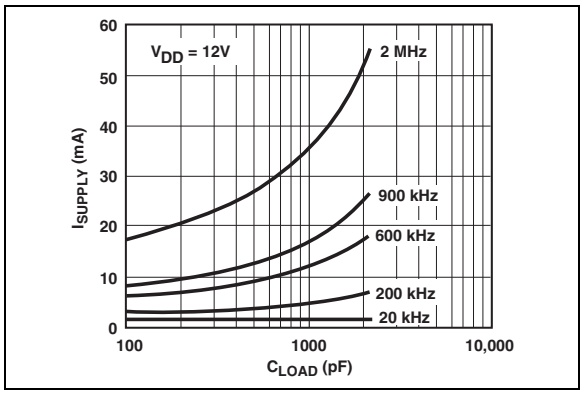


FIGURE 2-1: *Supply Current vs. Capacitive Load.*

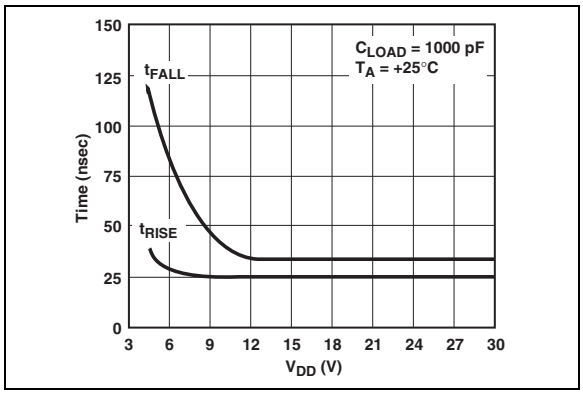


FIGURE 2-3: *Rise/Fall Time vs. V_{DD}.*

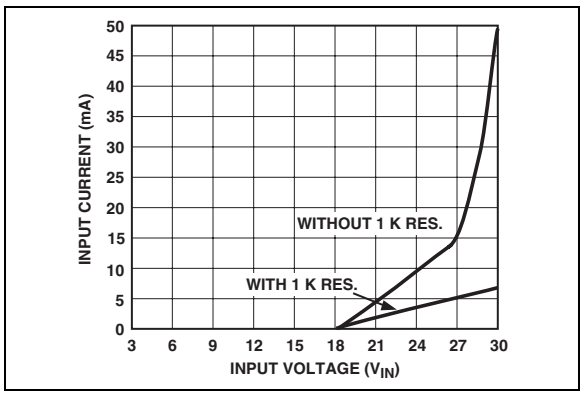


FIGURE 2-2: *Input Current vs. Input Voltage.*

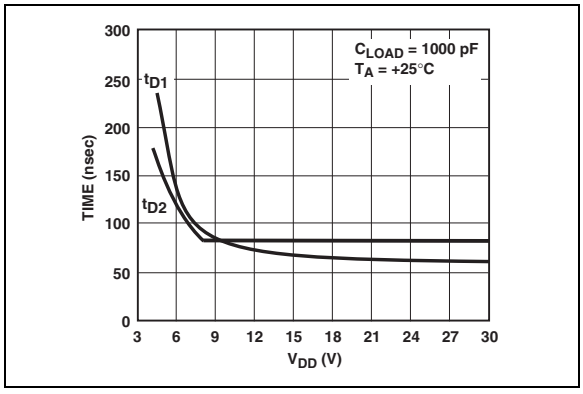


FIGURE 2-4: *t_{D1} and t_{D2} Delay vs. V_{DD}.*

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 lock-out 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 3A peak currents into capacitive loads and pin 6 (sink output) can sink 1.5A peak currents from a capacitive load.

4.0 APPLICATIONS INFORMATION

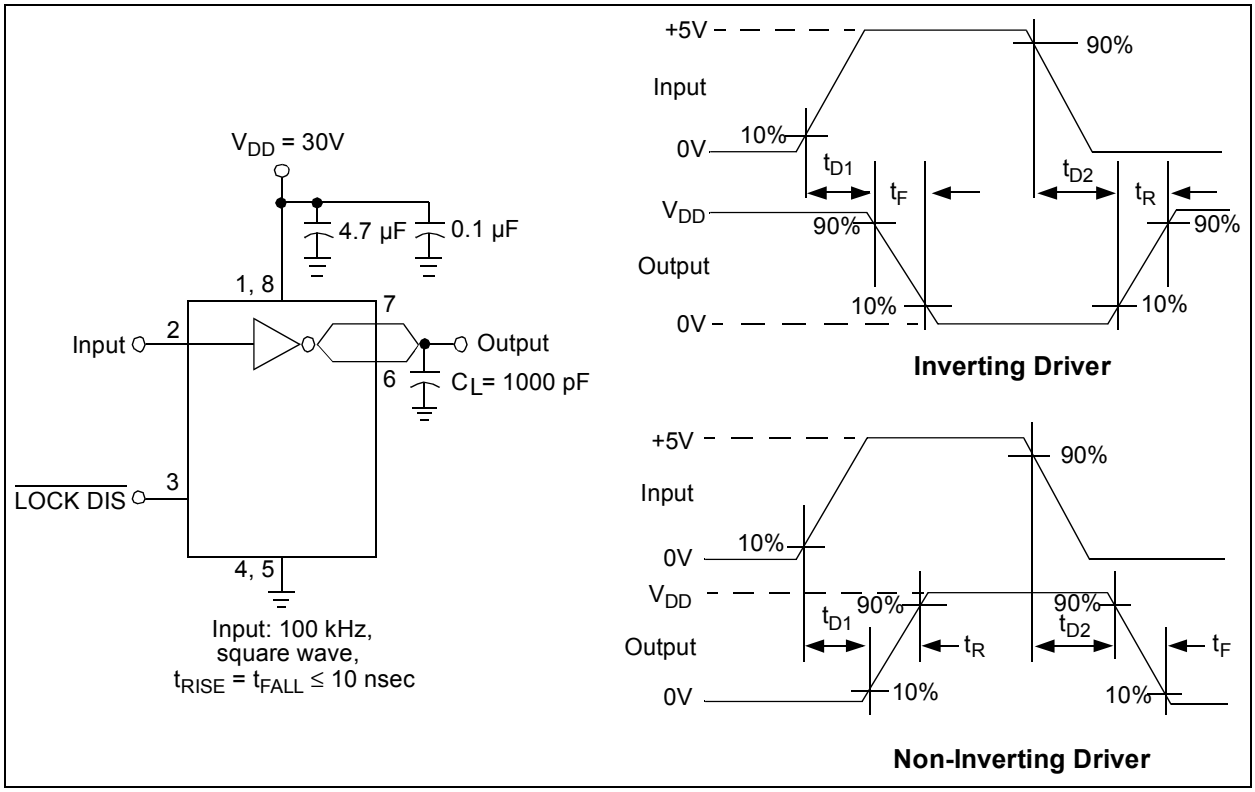
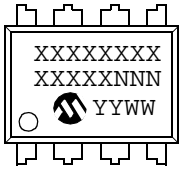


FIGURE 4-1: *Switching Time Test Circuit.*

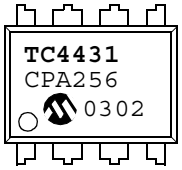
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

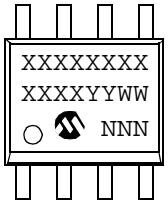
8-Lead PDIP (300 mil)



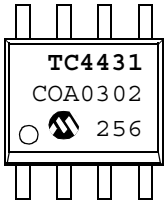
Example:



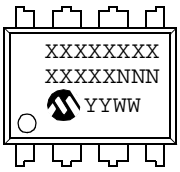
8-Lead SOIC (150 mil)



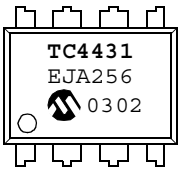
Example:



8-Lead CERDIP (300 mil)



Example:

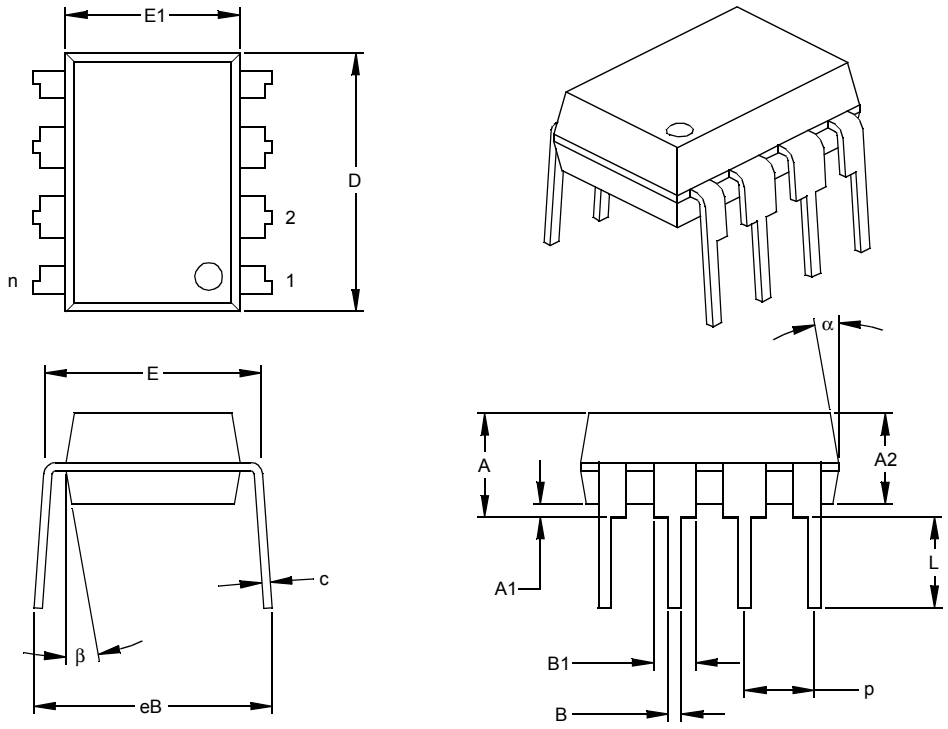


Legend:	XX...X	Customer specific information*
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code

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.

***** Standard OTP marking consists of Microchip part number, year code, week code, and traceability code.

8-Lead Plastic Dual In-line (P) – 300 mil (PDIP)

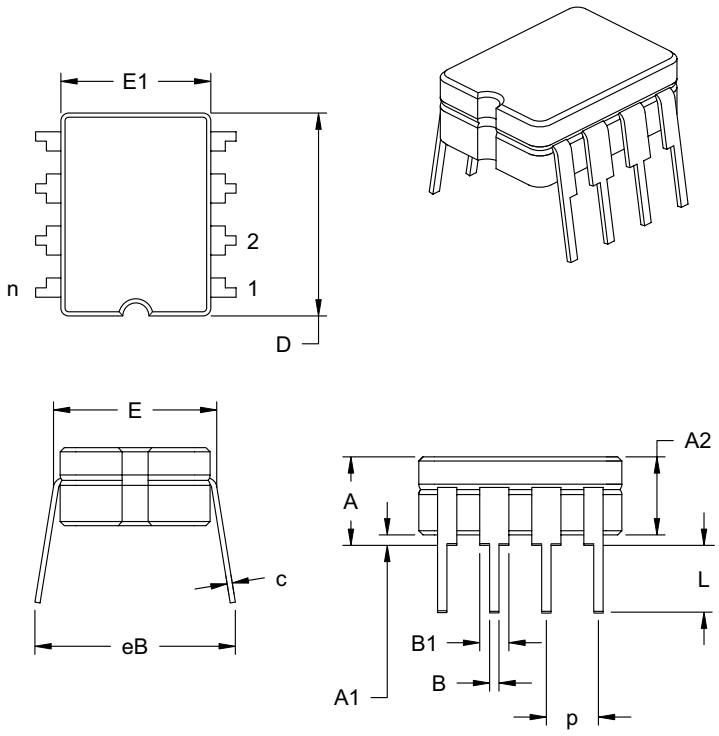


Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.100			2.54	
Top to Seating Plane	A	.140	.155	.170	3.56	3.94	4.32
Molded Package Thickness	A2	.115	.130	.145	2.92	3.30	3.68
Base to Seating Plane	A1	.015			0.38		
Shoulder to Shoulder Width	E	.300	.313	.325	7.62	7.94	8.26
Molded Package Width	E1	.240	.250	.260	6.10	6.35	6.60
Overall Length	D	.360	.373	.385	9.14	9.46	9.78
Tip to Seating Plane	L	.125	.130	.135	3.18	3.30	3.43
Lead Thickness	c	.008	.012	.015	0.20	0.29	0.38
Upper Lead Width	B1	.045	.058	.070	1.14	1.46	1.78
Lower Lead Width	B	.014	.018	.022	0.36	0.46	0.56
Overall Row Spacing §	eB	.310	.370	.430	7.87	9.40	10.92
Mold Draft Angle Top	α	5	10	15	5	10	15
Mold Draft Angle Bottom	β	5	10	15	5	10	15

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-001
Drawing No. C04-018

8-Lead Ceramic Dual In-line (JA) – 300 mil (CERDIP)



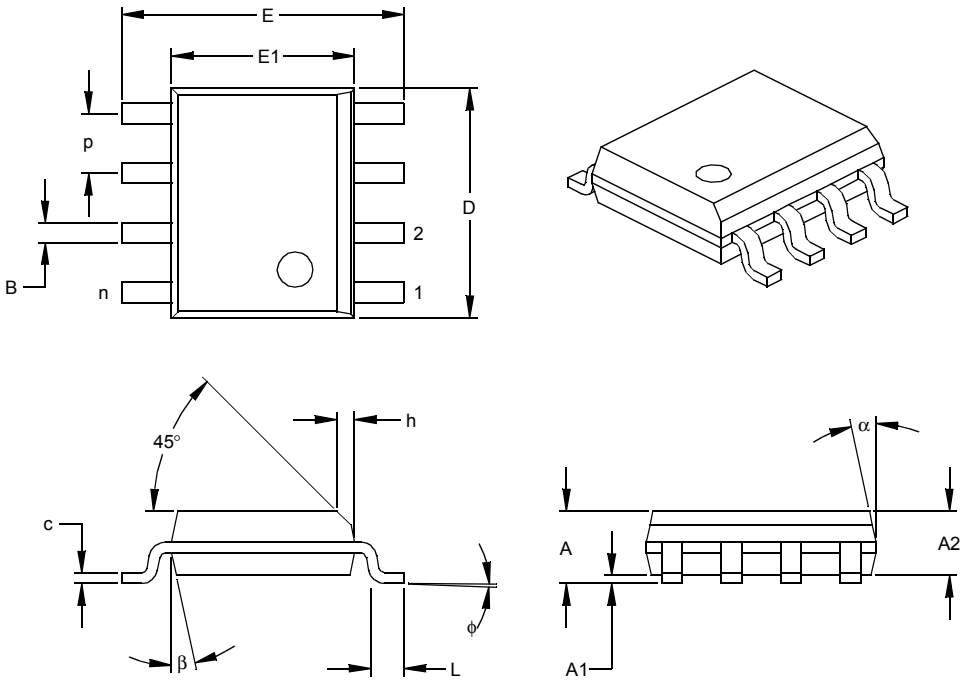
Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.100			2.54	
Top to Seating Plane	A	.160	.180	.200	4.06	4.57	5.08
Standoff §	A1	.020	.030	.040	0.51	0.77	1.02
Shoulder to Shoulder Width	E	.290	.305	.320	7.37	7.75	8.13
Ceramic Pkg. Width	E1	.230	.265	.300	5.84	6.73	7.62
Overall Length	D	.370	.385	.400	9.40	9.78	10.16
Tip to Seating Plane	L	.125	.163	.200	3.18	4.13	5.08
Lead Thickness	c	.008	.012	.015	0.20	0.29	0.38
Upper Lead Width	B1	.045	.055	.065	1.14	1.40	1.65
Lower Lead Width	B	.016	.018	.020	0.41	0.46	0.51
Overall Row Spacing	eB	.320	.360	.400	8.13	9.15	10.16

*Controlling Parameter

JEDEC Equivalent: MS-030

Drawing No. C04-010

8-Lead Plastic Small Outline (SN) – Narrow, 150 mil (SOIC)



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	p		.050			1.27	
Overall Height	A	.053	.061	.069	1.35	1.55	1.75
Molded Package Thickness	A2	.052	.056	.061	1.32	1.42	1.55
Standoff §	A1	.004	.007	.010	0.10	0.18	0.25
Overall Width	E	.228	.237	.244	5.79	6.02	6.20
Molded Package Width	E1	.146	.154	.157	3.71	3.91	3.99
Overall Length	D	.189	.193	.197	4.80	4.90	5.00
Chamfer Distance	h	.010	.015	.020	0.25	0.38	0.51
Foot Length	L	.019	.025	.030	0.48	0.62	0.76
Foot Angle	φ	0	4	8	0	4	8
Lead Thickness	c	.008	.009	.010	0.20	0.23	0.25
Lead Width	B	.013	.017	.020	0.33	0.42	0.51
Mold Draft Angle Top	α	0	12	15	0	12	15
Mold Draft Angle Bottom	β	0	12	15	0	12	15

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: MS-012
Drawing No. C04-057

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

PART NO.	X	/XX
Device	Temperature Range	Package

Device:	TC4431:	1.5A High-Speed 30V MOSFET Driver, Inverting
	TC4432:	1.5A High-Speed 30V MOSFET Driver, Non Inverting
Temperature Range:	C =	0°C to +70°C
	E =	-40°C to +85°C
Package:	JA =	Ceramic Dual In-line (300 mil Body), 8-lead *
	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.

Examples:

a) TC4431COA: 1.5A MOSFET driver, SOIC package, 0°C to +70°C.
b) TC4431EJA: 1.5A MOSFET driver, CERDIP package, -40ºC to +85ºC.

a) TC4432CPA: 1.5A MOSFET driver, PDIP package, 0°C to +70°C.
b) TC4432EPA: 1.5A MOSFET driver, PDIP package, -40°C to +85°C.

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