

12A High-Speed MOSFET Drivers

Features

- · High Peak Output Current: 13A (typ.)
- Low Shoot-Through/Cross-Conduction Current in Output Stage
- · Wide Input Supply Voltage Operating Range:
 - 4.5V to 18V
- · High Continuous Output Current: 2.6A (max.)
- · Matched Fast Rise and Fall Times:
 - 21 ns with 10,000 pF Load
 - 42 ns with 22,000 pF Load
- Matched Short Propagation Delays: 44 ns (typ.)
- · Low Supply Current:
 - With Logic '1' Input 140 μA (typ.)
 - With Logic '0' Input 40 μA (typ.)
- Low Output Impedance: 0.9Ω (typ.)
- Latch-Up Protected: Will Withstand 1.5A Output Reverse Current
- Input Will Withstand Negative Inputs Up To 5V
- Pin-Compatible with the TC4420/TC4429, TC4421/TC4422 and TC4421A/TC4422A MOSFET Drivers
- Space-Saving, Thermally-Enhanced, 8-Pin DFN Package

Applications

- · Line Drivers for Extra Heavily-Loaded Lines
- · Pulse Generators
- Driving the Largest MOSFETs and IGBTs
- Local Power ON/OFF Switch
- Motor and Solenoid Driver
- LF Initiator

General Description

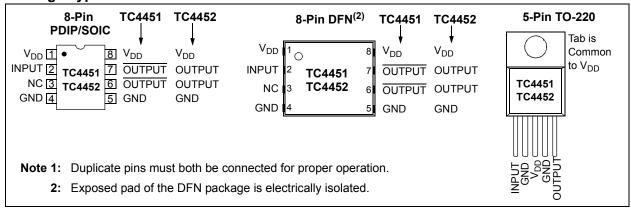
The TC4451/TC4452 are single-output MOSFET drivers. These devices are high-current buffer/drivers capable of driving large MOSFETs and Insulated Gate Bipolar Transistors (IGBTs). The TC4451/TC4452 have matched output rise and fall times, as well as matched leading and falling-edge propagation delay times. The TC4451/TC4452 devices also have very low cross-conduction current, reducing the overall power dissipation of the device.

These devices are essentially immune to any form of upset, except direct overvoltage or over-dissipation. They cannot be latched under any conditions within their power and voltage ratings. These parts are not subject to damage or improper operation when up to 5V of ground bounce is present on their ground terminals. They can accept, without damage or logic upset, more than 1.5A inductive current of either polarity being forced back into their outputs. In addition, all terminals are fully protected against up to 4 kV of electrostatic discharge.

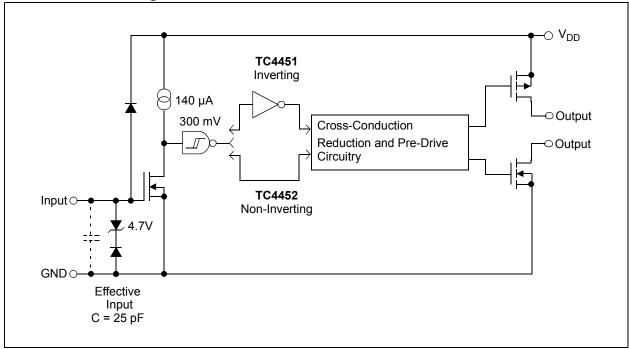
The TC4451/TC4452 inputs may be driven directly from either TTL or CMOS (3V to 18V). In addition, 300 mV of hysteresis is built into the input, providing noise immunity and allowing the device to be driven from slowly rising or falling waveforms.

With both surface-mount and pin-through-hole packages, in addition to a wide operating temperature range, the TC4451/TC4452 family of 12A MOSFET drivers fit into most any application where high gate/line capacitance drive is required.

Package Types⁽¹⁾



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage	+20V
Input Voltage (V _{DD} + 0.3V) to	(GND – 5V)
Input Current (V _{IN} > V _{DD})	50 mA

† 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, $T_A = +25^{\circ}C$ with $4.5V \le V_{DD} \le 18V$.									
Parameters	Sym	Min	Тур	Max	Units	Conditions			
Input									
Logic '1', High Input Voltage	V _{IH}	2.4	1.5	_	V				
Logic '0', Low Input Voltage	V_{IL}	_	1.3	0.8	V				
Input Current	I _{IN}	-10		+10	μΑ	$0V \le V_{IN} \le V_{DD}$			
Input Voltage	V_{IN}	– 5	1	$V_{DD} + 0.3$	V				
Output									
High Output Voltage	V_{OH}	V _{DD} – 0.025		_	>	DC Test			
Low Output Voltage	V_{OL}	_		0.025	>	DC Test			
Output Resistance, High	R_{OH}	_	1.0	1.5	Ω	$I_{OUT} = 10 \text{ mA}, V_{DD} = 18V$			
Output Resistance, Low	R_{OL}	_	0.9	1.5	Ω	I_{OUT} = 10 mA, V_{DD} = 18V			
Peak Output Current	I_{PK}	_	13	_	Α	V _{DD} = 18V			
Continuous Output Current	I_{DC}	2.6		_	Α	$10V \le V_{DD} \le 18V$ (Note 2, Note 3)			
Latch-Up Protection Withstand Reverse Current	I _{REV}	_	>1.5	_	Α	Duty cycle \leq 2%, t \leq 300 μ s			
Switching Time (Note 1)									
Rise Time	t _R	_	30	40	ns	Figure 4-1 , C _L = 15,000 pF			
Fall Time	t _F	_	32	40	ns	Figure 4-1 , C _L = 15,000 pF			
Propagation Delay Time	t _{D1}	_	44	52	ns	Figure 4-1 , C _L = 15,000 pF			
Propagation Delay Time	t _{D2}	_	44	52	ns	Figure 4-1 , C _L = 15,000 pF			
Power Supply									
Power Supply Current	I _S	_	140	200	μΑ	V _{IN} = 3V			
		_	40	100	μA	V _{IN} = 0V			
Operating Input Voltage	V_{DD}	4.5		18.0	V				

- Note 1: Switching times ensured by design.
 - 2: Tested during characterization, not production tested.
 - 3: Valid for AT and MF packages only. $T_A = +25$ °C.

DC CHARACTERISTICS (OVER OPERATING TEMPERATURE RANGE)

Electrical Specifications: Unless otherwise noted, over operating temperature range with $4.5V \le V_{DD} \le 18V$.									
Parameters	Sym	Min	Тур	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	I _{IN}	-10	_	+10	μΑ	$0V \le V_{IN} \le V_{DD}$			
Output									
High Output Voltage	V _{OH}	V _{DD} – 0.025	_	_	V	DC Test			
Low Output Voltage	V _{OL}	_	_	0.025	V	DC Test			
Output Resistance, High	R _{OH}	_	_	2.2	Ω	I _{OUT} = 10 mA, V _{DD} = 18V			
Output Resistance, Low	R _{OL}	_	_	2.0	Ω	I _{OUT} = 10 mA, V _{DD} = 18V			
Switching Time (Note 1)									
Rise Time	t _R	_	35	60	ns	Figure 4-1 , C _L = 15,000 pF			
Fall Time	t _F	_	38	60	ns	Figure 4-1 , C _L = 15,000 pF			
Propagation Delay Time	t _{D1}	_	55	65	ns	Figure 4-1 , C _L = 15,000 pF			
Propagation Delay Time	t _{D2}	_	55	65	ns	Figure 4-1 , C _L = 15,000 pF			
Power Supply	Power Supply								
Power Supply Current	I _S	_	200	400	μA	V _{IN} = 3V			
		_	50	150	μΑ	V _{IN} = 0V			
Operating Input Voltage	V_{DD}	4.5	_	18.0	V				

Note 1: Switching times ensured by design.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, all parameters apply with $4.5V \le V_{DD} \le 18V$.									
Parameters	Sym	Min	Тур	Max	Units	Conditions			
Temperature Ranges									
Specified Temperature Range (V)	T _A	-40	_	+125	°C				
Maximum Junction Temperature	TJ	_	_	+150	°C				
Storage Temperature Range	T _A	-65	_	+150	°C				
Package Thermal Resistances									
Thermal Resistance, 5L-TO-220	θ_{JA}	_	71	_	°C/W	Without heat sink			
Thermal Resistance, 8L-6x5 DFN	θ_{JA}	_	33.2	_	°C/W	Typical 4-layer board with vias to ground plane			
Thermal Resistance, 8L-PDIP	θ_{JA}	_	125	_	°C/W				
Thermal Resistance, 8L-SOIC	θ_{JA}	_	155	_	°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°C with 4.5V \leq V_{DD} \leq 18V.

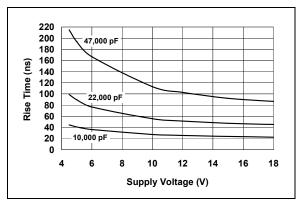


FIGURE 2-1: Rise Time vs. Supply Voltage.

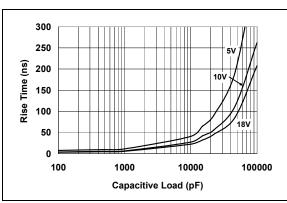


FIGURE 2-2: Rise Time vs. Capacitive Load.

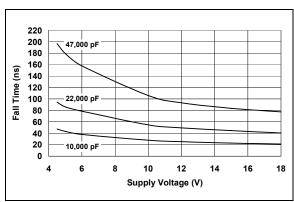


FIGURE 2-3: Fall Time vs. Supply Voltage.

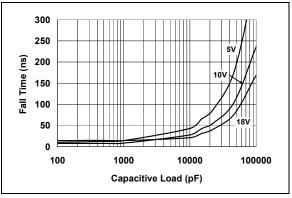


FIGURE 2-4: Fall Time vs. Capacitive Load.

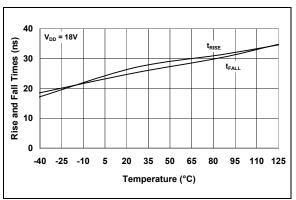


FIGURE 2-5: Rise and Fall Times vs. Temperature.

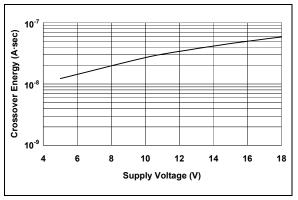


FIGURE 2-6: Crossover Energy vs. Supply Voltage.

Note: Unless otherwise indicated, $T_A = +25^{\circ}C$ with $4.5V \le V_{DD} \le 18V$.

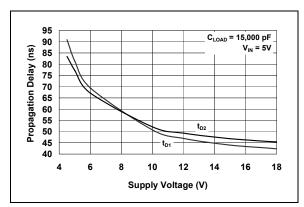


FIGURE 2-7: Propagation Delay vs. Supply Voltage.

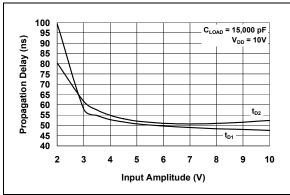


FIGURE 2-8: Propagation Delay vs. Input Amplitude.

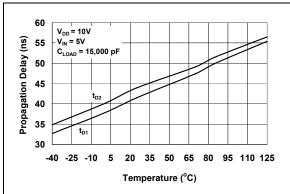


FIGURE 2-9: Propagation Delay vs. Temperature.

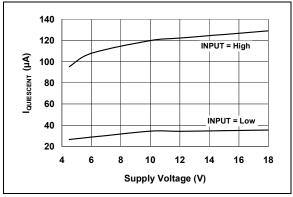


FIGURE 2-10: Quiescent Supply Current vs. Supply Voltage.

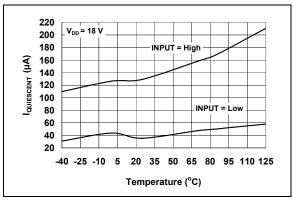


FIGURE 2-11: Quiescent Supply Current vs. Temperature.

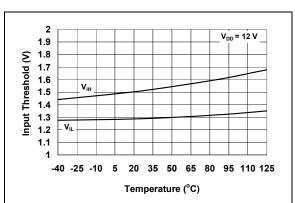


FIGURE 2-12: Input Threshold vs. Temperature.

Note: Unless otherwise indicated, T_A = +25°C with 4.5V \leq V_{DD} \leq 18V.

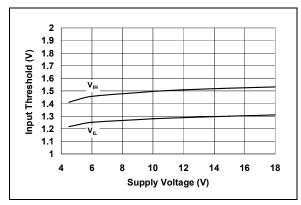


FIGURE 2-13: Input Threshold vs. Supply Voltage.

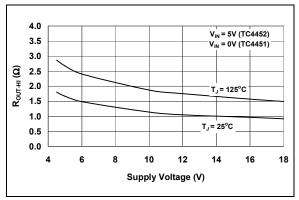


FIGURE 2-14: High-State Output Resistance vs. Supply Voltage.

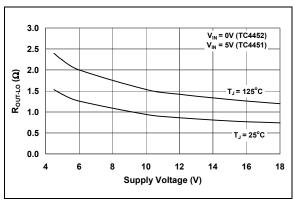


FIGURE 2-15: Low-State Output Resistance vs. Supply Voltage.

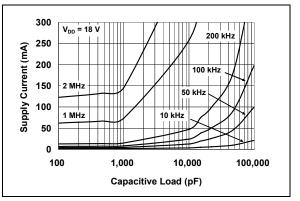


FIGURE 2-16: Supply Current vs. Capacitive Load ($V_{DD} = 18V$).

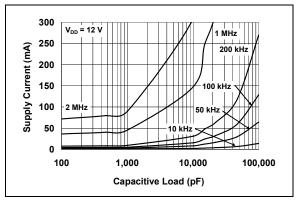


FIGURE 2-17: Supply Current vs. Capacitive Load ($V_{DD} = 12V$).

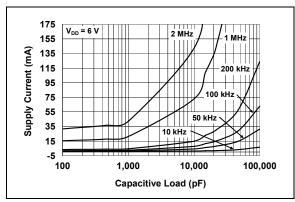


FIGURE 2-18: Supply Current vs. Capacitive Load ($V_{DD} = 6V$).

Note: Unless otherwise indicated, T_A = +25°C with 4.5V \leq V_{DD} \leq 18V.

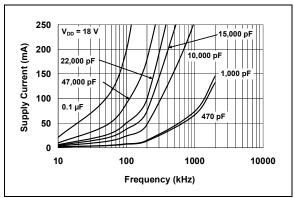


FIGURE 2-19: Supply Current vs. Frequency $(V_{DD} = 18V)$.

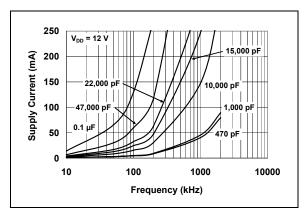


FIGURE 2-20: Supply Current vs. Frequency $(V_{DD} = 12V)$.

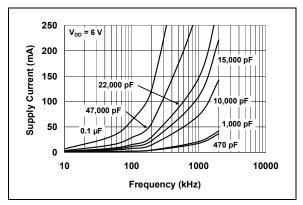


FIGURE 2-21: Supply Current vs. Frequency $(V_{DD} = 6V)$.

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin No. 8-Pin PDIP, SOIC	Pin No. 8-Pin DFN	Pin No. 5-Pin TO-220	Symbol	Description
1	1		V_{DD}	Supply input, 4.5V to 18V
2	2	1	INPUT	Control input, TTL/CMOS-compatible input
3	3	_	NC	No connection
4	4	2	GND	Ground
5	5	4	GND	Ground
6	6	5	OUTPUT	CMOS push-pull output
7	7	_	OUTPUT	CMOS push-pull output
8	8	3	V_{DD}	Supply input, 4.5V to 18V
	PAD	_	NC	Exposed metal pad
_	_	TAB	V_{DD}	Metal tab is at the V _{DD} potential

3.1 Supply Input (V_{DD})

The V_{DD} input is the bias supply for the MOSFET driver and is rated for 4.5V to 18V with respect to the ground pin. The V_{DD} input should be bypassed to ground with a local ceramic capacitor. The value of the capacitor should be chosen based on the capacitive load that is being driven. A minimum value of 1.0 μ F is suggested.

3.2 Control Input

The MOSFET driver input is a high-impedance, TTL/CMOS-compatible input. The input also has 300 mV of hysteresis between the high and low thresholds that prevents output glitching even when the rise and fall time of the input signal is very slow.

3.3 CMOS Push-Pull Output

The MOSFET driver output is a low-impedance, CMOS, push-pull style output capable of driving a capacitive load with 12A peak currents. The MOSFET driver output is capable of withstanding 1.5A peak reverse currents of either polarity.

3.4 Ground

The ground pins are the return path for the bias current and for the high peak currents that discharge the load capacitor. The ground pins should be tied into a ground plane or have very short traces to the bias supply source return.

3.5 Exposed Metal Pad

The exposed metal pad of the 6x5 DFN package is not internally connected to any potential. Therefore, this pad can be connected to a ground plane or other copper plane on a Printed Circuit Board (PCB) to aid in heat removal from the package.

3.6 Metal Tab

The metal tab of the TO-220 package is connected to the V_{DD} potential of the device. This connection to V_{DD} can be used as a current carrying path for the device.

4.0 APPLICATIONS INFORMATION

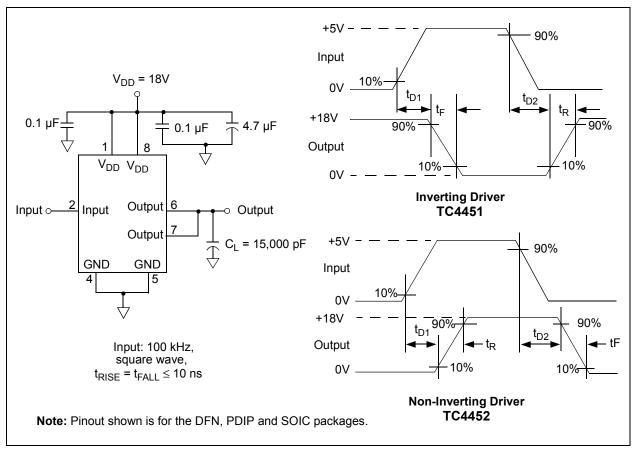
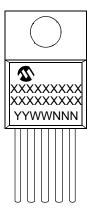


FIGURE 4-1: Switching Time Test Circuits.

5.0 PACKAGING INFORMATION

5.1 **Package Marking Information**

5-Lead TO-220



8-Lead DFN-S



8-Lead PDIP (300 mil)



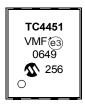
8-Lead SOIC (150 mil)



Example:



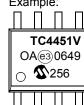
Example:



Example:



Example:



Legend: XX...X Customer-specific information

Year code (last digit of calendar year) Υ YY Year code (last 2 digits of calendar year) ww Week code (week of January 1 is week '01')

NNN Alphanumeric traceability code

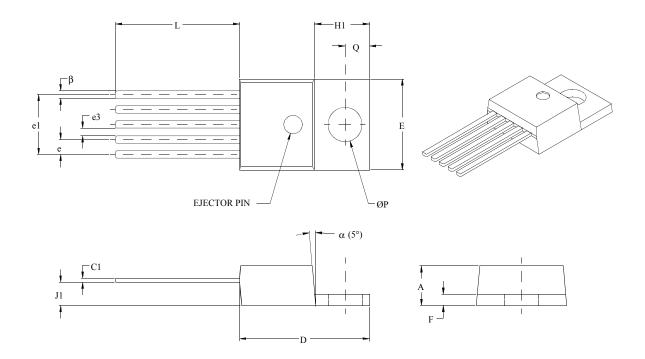
(e3) Pb-free JEDEC designator for Matte Tin (Sn)

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.

5-Lead Plastic Transistor Outline (AT) (TO-220)



	Units INCHES*		MILLIME	TERS	
Dimension Limits		MIN	MAX	MIN	MAX
Lead Pitch	е	.060	.072	1.52	1.83
Overall Lead Centers	e1	.263	.273	6.68	6.93
Space Between Leads	e3	.030	.040	0.76	1.02
Overall Height	Α	.160	.190	4.06	4.83
Overall Width	E	.385	.415	9.78	10.54
Overall Length	D	.560	.590	14.22	14.99
Flag Length	H1	.234	.258	5.94	6.55
Flag Thickness	F	.045	.055	1.14	1.40
Through Hole Center	Q	.103	.113	2.62	2.87
Through Hole Diameter	Р	.146	.156	3.71	3.96
Lead Length	L	.540	.560	13.72	14.22
Base to Bottom of Lead	J1	.090	.115	2.29	2.92
Lead Thickness	C1	.014	.022	0.36	0.56
Lead Width	β	.025	.040	0.64	1.02
Mold Draft Angle	α	3°	7°	3°	7°

^{*} Controlling Parameter

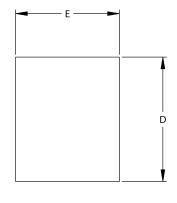
Notes:

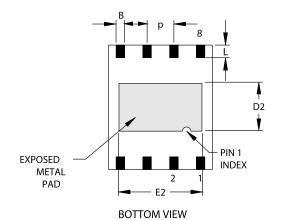
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254 mm) per side. JEDEC equivalent: TO-220

Drawing No. C04-036

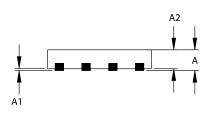
Revised 08-01-05

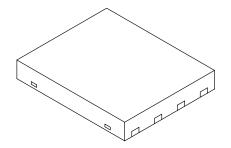
8-Lead Plastic Dual Flat No Lead Package (MF) 6x5 mm Body (DFN-S) – Saw Singulated





TOP VIEW





	Units		INCHES		М	ILLIMETERS*	
Dimensio	on Limits	MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	р		.050 BSC			1.27 BSC	
Overall Height	Α	.033	.035	.037	0.85	0.90	0.95
Package Thickness	A2	.031	.035	.037	0.80	0.89	0.95
Standoff	A1	.000	.0004	.002	0.00	0.01	0.05
Base Thickness	A3	.007	.008	.009	0.17	0.20	0.23
Overall Length	E	.195	.197	.199	4.95	5.00	5.05
Exposed Pad Length	E2	.152	.157	.163	3.85	4.00	4.15
Overall Width	D	.234	.236	.238	5.95	6.00	6.05
Exposed Pad Width	D2	.089	.091	.093	2.25	2.30	2.35
Lead Width	В	.014	.016	.019	0.35	0.40	0.47
Lead Length	L	.024		.026	0.60		0.65

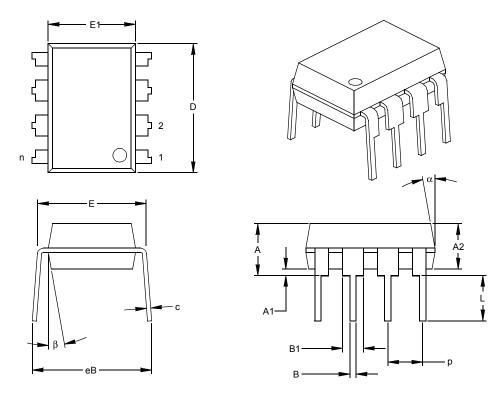
Notes:

JEDEC equivalent: MO-220

Drawing No. C04-122

Revised 11/3/03

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



	Units		INCHES*			MILLIMETERS		
Dimensior	Limits	MIN	NOM	MAX	MIN	NOM	MAX	
Number of Pins	n		8			8		
Pitch	р		.100			2.54		
Top to Seating Plane	Α	.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	Е	.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	С	.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	В	.014	.018	.022	0.36	0.46	0.56	
Overall Row Spacing §	eВ	.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	

Notes:

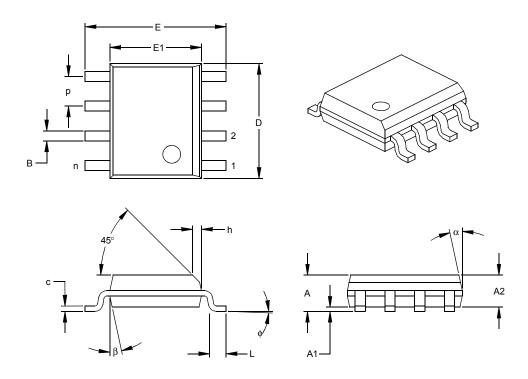
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed

.010" (0.254mm) per side.
JEDEC Equivalent: MS-001

Drawing No. C04-018

^{*} Controlling Parameter § Significant Characteristic

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



	Units	INCHES*		N	3		
Dimension	Limits	MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		8			8	
Pitch	р		.050			1.27	
Overall Height	Α	.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	Е	.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	ф	0	4	8	0	4	8
Lead Thickness	С	.008	.009	.010	0.20	0.23	0.25
Lead Width	В	.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

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

^{*} Controlling Parameter § Significant Characteristic

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (February 2006)

• Original Release of this Document.

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	<u>xx</u>	Exa	Examples:				
Device Tempe Ran	o .	a)	TC4451VAT:	12A High-Speed Inverting MOSFET Driver, TO-220 package			
Device:	TC4451: 12A High-Speed MOSFET Driver, Inverting TC4452: 12A High-Speed MOSFET Driver, Non-Inverting	b)	TC4451VOA:	12A High-Speed Inverting MOSFET Driver, SOIC package			
Temperature Range:	V = -40°C to +125°C	c)	TC4451VMF:	12A High-Speed Inverting MOSFET Driver, DFN package			
Package: *	AT = TO-220, 5-lead MF = Dual, Flat, No-Lead (6x5 mm Body), 8-lead MF713 = Dual, Flat, No-Lead (6x5 mm Body), 8-lead	a)	TC4452VPA:	12A High-Speed Non-Inverting MOSFET Driver, PDIP package			
	(Tape and Reel) PA = Plastic DIP (300 mil Body), 8-lead OA = Plastic SOIC (150 mil Body), 8-lead OA713 = Plastic SOIC (150 mil Body), 8-lead (Tape and Reel)	b)	TC4452VOA:	12A High-Speed Non-Inverting MOSFET Driver, SOIC package			
	*All package offerings are Pb Free (Lead Free).	c)	TC4452VMF:	12A High-Speed Non-Inverting MOSFET Driver, DFN package			

NOTES:

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