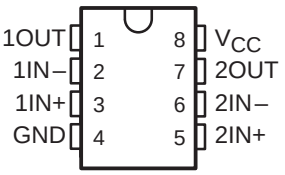
- **Low-Voltage and Single-Supply Operation V_{CC} = 2 V to 7 V**
- **Common-Mode Voltage Range That Includes Ground**

D, P, OR PW PACKAGE
(TOP VIEW)



description

The TL393 is a dual differential comparator built using a new Texas Instruments-developed bipolar process. The TL393 is intended as an enhanced alternative to the industry-standard LM393 in circuits with supply-voltage limits of 7 V.

The new bipolar process allows the TL393 to perform with lower supply-current requirements than the LM393 (0.7 mA typical) while still providing a faster response time than the older device.

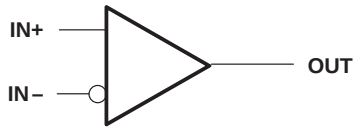
Package availability for this device includes the TSSOP (thin-shrink small-outline package). With a maximum thickness of 1.1 mm and a package area that is 25% smaller than the standard surface-mount package, the TSSOP is ideal for high-density circuits, particularly in hand-held and portable equipment.

AVAILABLE OPTIONS

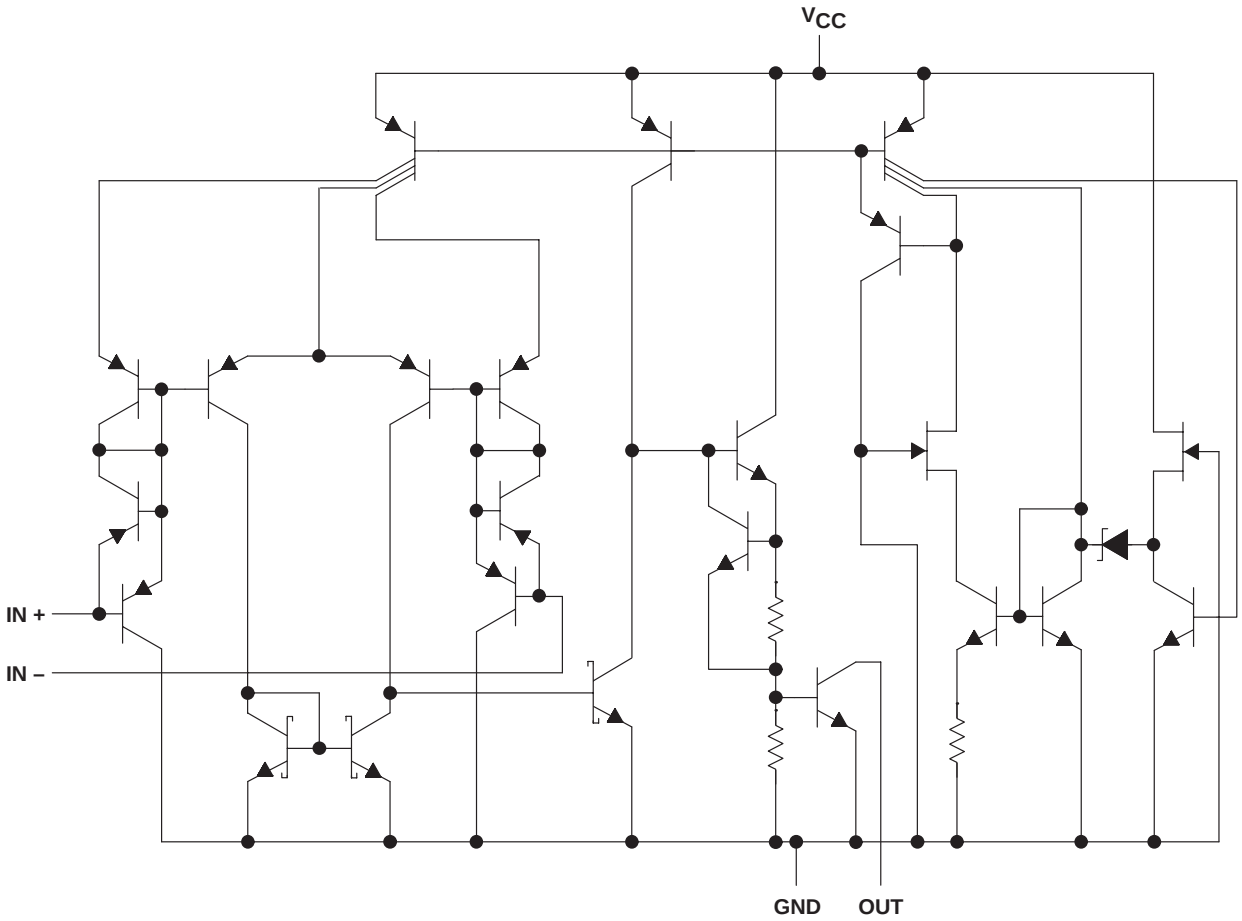
T_A	SUPPLY CURRENT (TYP)	RESPONSE TIME (TYP)	PACKAGED DEVICES			CHIP FORM (Y)
			SMALL OUTLINE (D)	PLASTIC DIP (P)	TSSOP (PW)†	
–40°C to 105°C	0.7 mA	0.65 μs	TL393ID	TL393IP	TL393IPWLE	TL393Y

† The PW packages are only available left-ended taped and reeled (e.g., TL393IPWLE).

symbol (each comparator)



equivalent schematic (each comparator)

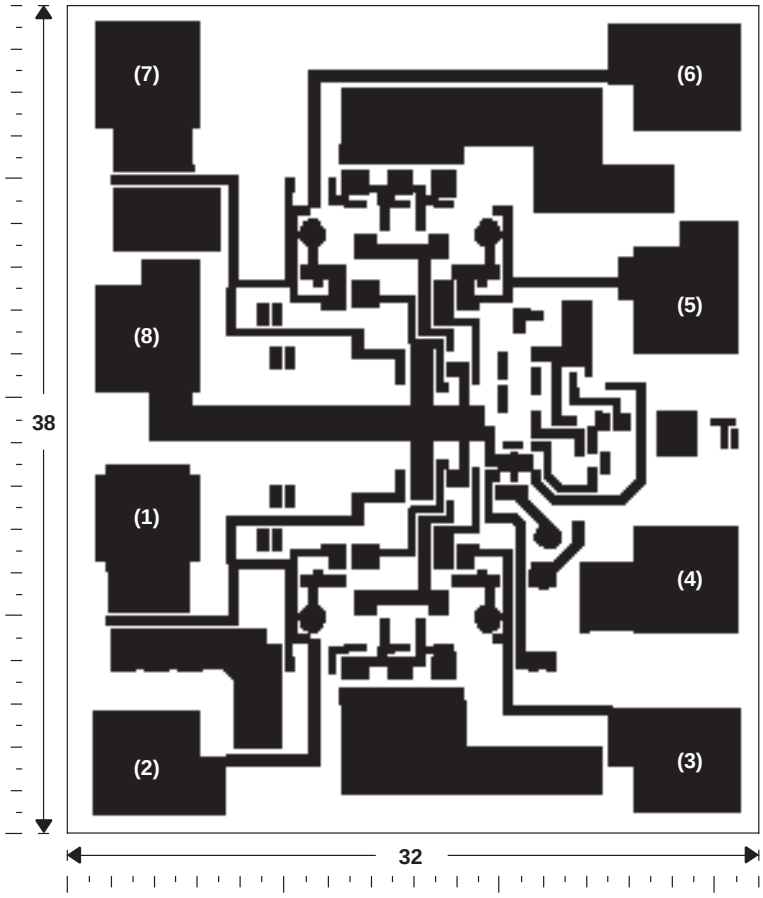


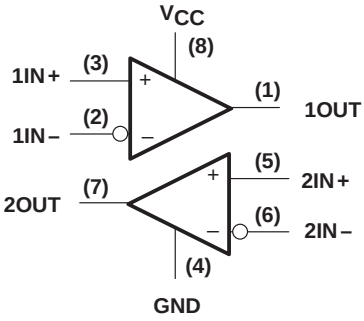
COMPONENT COUNT	
Transistors	48
Resistors	5
Diodes	7
Epi-FETs	2

TL393Y chip information

This chip, when properly assembled, displays characteristics similar to the TL393. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 13 TYPICAL

BONDING PADS: 3.54 × 3.54 MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

PIN (4) IS INTERNALLY CONNECTED TO BACKSIDE OF CHIP.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Differential input voltage, V_{ID} (see Note 2) . . . . . 7 V
Input voltage, V_I (any input) . . . . . 7 V
Output voltage, V_O . . . . . 7 V
Output current, I_O (each output) . . . . . 20 mA
Duration of short-circuit current to GND (see Note 3) . . . . . unlimited
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A . . . . . –40°C to 105°C
Storage temperature range . . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

† Stresses beyond 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 beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, except differential voltages, are with respect to network GND.
2. Differential voltages are at IN+ with respect to IN –.
3. Short circuits from the outputs to V_{CC} can cause excessive heating and eventual destruction of the chip.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW
PW	525 mW	4.2 mW/°C	336 mW	273 mW

recommended operating conditions

	MIN	MAX	UNIT
Supply voltage, V_{CC}	2	7	V
Operating free-air temperature, T_A	–40	105	°C

electrical characteristics, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TL393			UNIT
				MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 1.4 V, V_{IC} = V_{ICR}min	25°C		1.5	5	mV
			Full range			9	
V_{ICR}	Common-mode input voltage range		25°C	0 to V_{CC} –1.5	0 to V_{CC} –1.2		V
			Full range	0 to V_{CC} –2			
V_{OL}	Low-level output voltage	V_{ID} = –1 V, I_{OL} = 1 mA	25°C		70	300	mV
		V_{ID} = –1 V, I_{OL} = 4 mA	Full range		200	700	
I_{IO}	Input offset current	V_O = 1.4 V	25°C		5	50	nA
			Full range			150	
I_{IB}	Input bias current	V_O = 1.4 V	25°C		–40	–250	nA
			Full range			–400	
I_{OH}	High-level output current	V_{ID} = 1 V, V_{OH} = 3 V	25°C		0.1		nA
		V_{ID} = 1 V, V_{OH} = 5 V	Full range			100	
I_{OL}	low-level output current	V_{ID} = –1 V, V_{OL} = 1.5 V	25°C	6			mA
I_{CCH}	High-level supply current	V_O = V_{OH}	25°C		140	200	µA
			Full range			300	
I_{CCL}	Low-level supply current	V_O = V_{OL}	25°C		0.8	1	mA
			Full range			1.2	

† Full range is –40°C to 105°C.

switching characteristics, V_{CC} = 5 V, C_L = 15 pF, T_A = 25°C

PARAMETER	TEST CONDITIONS	TL393			UNIT
		MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive, R_L connected to 5 V through 5.1 kΩ		0.65		µs
	TTL-level input step, R_L connected to 5 V through 5.1 kΩ		0.2		

electrical characteristics, V_{CC} = 5 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TL393Y			UNIT
			MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 1.4 V,		1.5	5	mV
V_{ICR}	Common-mode input voltage range		0 to V_{CC} – 1.5	0 to V_{CC} – 1.2		V
V_{OL}	Low-level output voltage	V_{ID} = –1 V, I_{OL} = 1 mA		70	300	mV
I_{IO}	Input offset current	V_O = 1.4 V		5	50	nA
I_{IB}	Input bias current	V_O = 1.4 V		–40	–250	nA
I_{OH}	High-level output current	V_{ID} = 1 V, V_{OH} = 3 V		0.1		nA
I_{OL}	low-level output current	V_{ID} = –1 V, V_{OL} = 1.5 V	6			mA
I_{CCH}	High-level supply current	V_O = V_{OH}		140	200	µA
I_{CCL}	Low-level supply current	V_O = V_{OL}		0.8	1	mA

switching characteristics, V_{CC} = 5 V, C_L = 15 pF, T_A = 25°C

PARAMETER	TEST CONDITIONS		TL393Y			UNIT
			MIN	TYP	MAX	
Response time	100-mV input step with 5-mV overdrive,	R_L connected to 5 V through 5.1 kΩ		0.65		µs
	TTL-level input step,	R_L connected to 5 V through 5.1 kΩ		0.2		

TYPICAL CHARACTERISTICS

LOW- TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

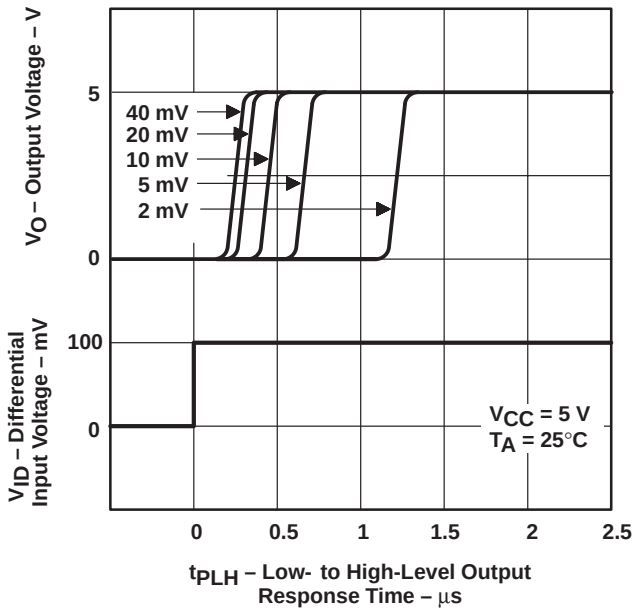


Figure 1

HIGH- TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

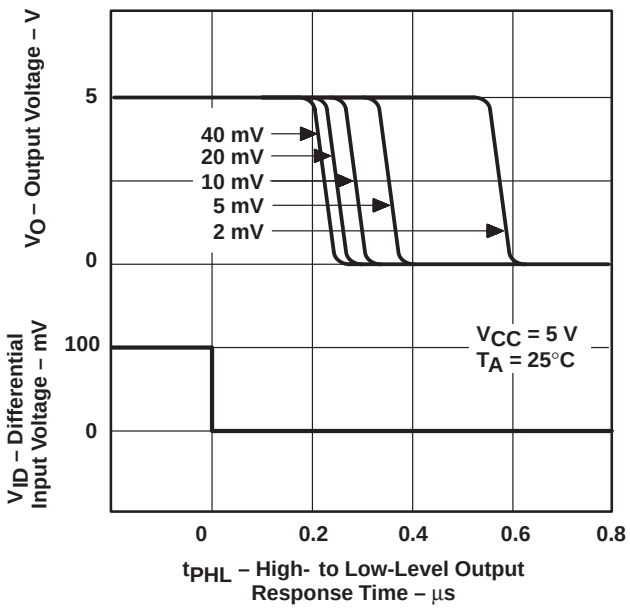


Figure 2

PACKAGING INFORMATION

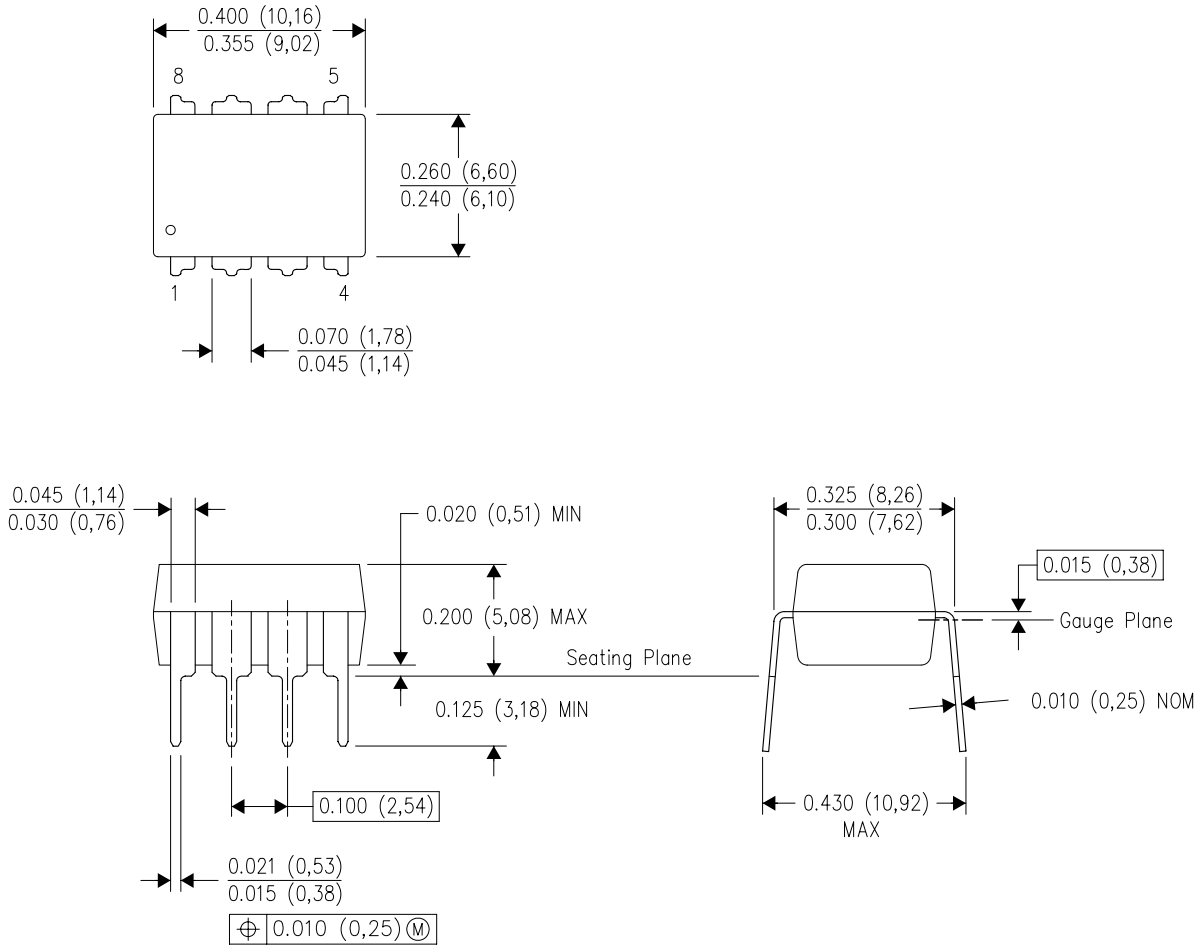
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TL393ID	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TL393IDR	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TL393IP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TL393IPWLE	OBSOLETE	TSSOP	PW	8		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

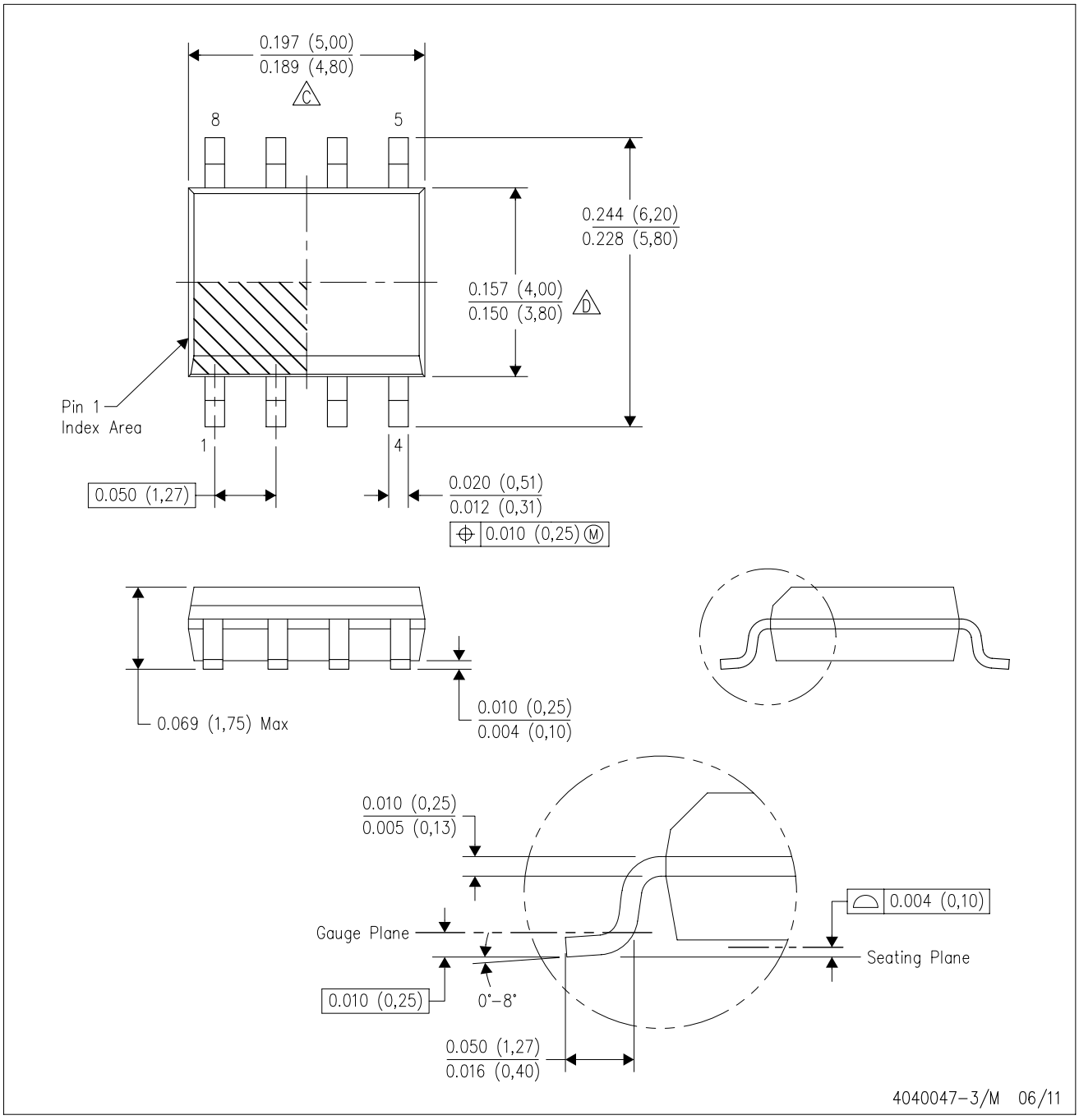
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

P (R–PDIP–T8) PLASTIC DUAL–IN–LINE PACKAGE



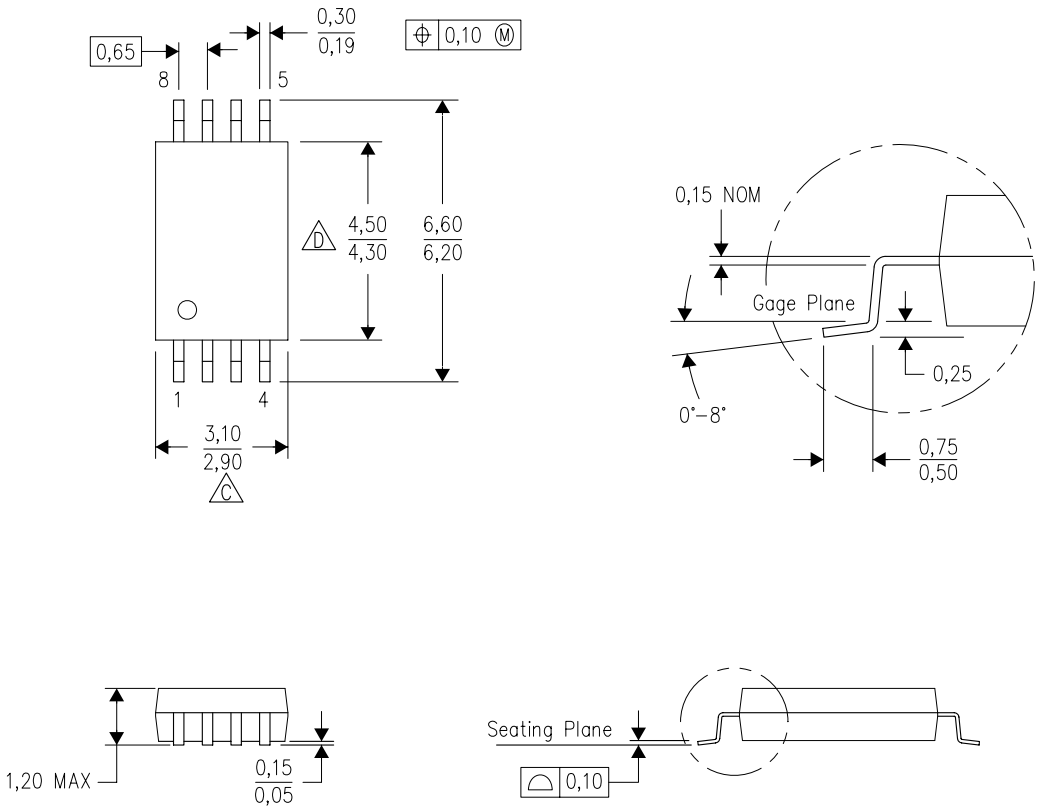
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

PW (R–PDSO–G8) PLASTIC SMALL OUTLINE



4040064–2/G 02/11

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com	Wireless	www.ti.com/wireless-apps
RF/IF and ZigBee® Solutions	www.ti.com/lprf		
	TI E2E Community Home Page		e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265