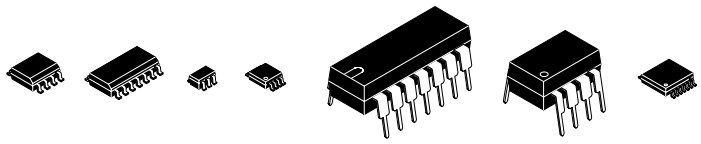


SLCS137B – NOVEMBER 2000 – REVISED AUGUST 2001

FAMILY OF NANOPOWER PUSH-PULL OUTPUT COMPARATORS

FEATURES

- **Low Supply Current . . . 560 nA/Per Channel**
- **Input Common-Mode Range Exceeds the Rails . . . –0.1 V to V_{CC} + 5 V**
- **Supply Voltage Range . . . 2.5 V to 16 V**
- **Reverse Battery Protection Up to 18 V**
- **Push-Pull CMOS Output Stage**
- **Specified Temperature Range**
  - **0°C to 70°C – Commercial Grade**
  - **–40°C to 125°C – Industrial Grade**
- **Ultrasmall Packaging**
  - **5-Pin SOT-23 (TLV3701)**
  - **8-Pin MSOP (TLV3702)**
- **Universal Op-Amp EVM (Reference SLOU060 for more information)**

APPLICATIONS

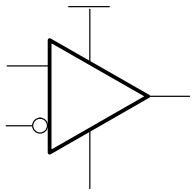
- **Portable Battery Monitoring**
- **Consumer Medical Electronics**
- **Security Detection Systems**

DESCRIPTION

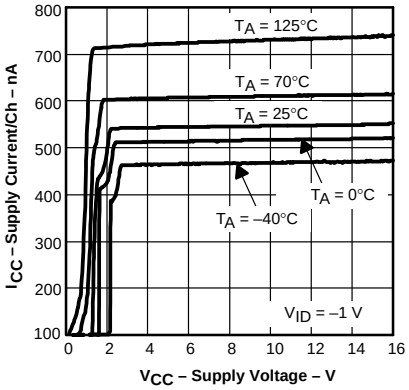
The TLV370x is Texas Instruments' first family of nanopower comparators with only 560 nA per channel supply current, which make this device ideal for battery power and wireless handset applications.

The TLV370x has a minimum operating supply voltage of 2.7 V over the extended industrial temperature range (T_A = –40°C to 125°C), while having an input common-mode range of –0.1 to V_{CC} + 5 V. The low supply current makes it an ideal choice for battery powered portable applications where quiescent current is the primary concern. Reverse battery protection guards the amplifier from an over-current condition due to improper battery installation. For harsh environments, the inputs can be taken 5 V above the positive supply rail without damage to the device.

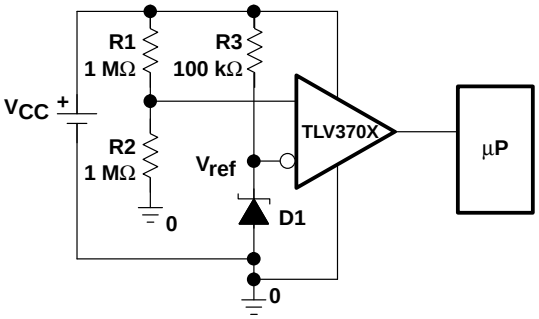
All members are available in PDIP and SOIC with the singles in the small SOT-23 package, duals in the MSOP, and quads in the TSSOP package.



SUPPLY CURRENT vs SUPPLY VOLTAGE



high side voltage sense circuit



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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A SELECTION OF OUTPUT COMPARATORS†

DEVICE	V_{CC} (V)	V_{IO} (μV)	I_{CC}/Ch (μA)	I_{IB} (pA)	t_{PLH} (μs)	t_{PHL} (μs)	t_f (μs)	t_r (μs)	RAIL-TO-RAIL	OUTPUT STAGE
TLV370x	2.5 – 16	250	0.56	80	56	83	22	8	I	PP
TLV340x	2.5 – 16	250	0.47	80	55	30	5	–	I	OD
TLC3702/4	3 – 16	1200	9	5	1.1	0.65	0.5	0.125	–	PP
TLC393/339	3 – 16	1400	11	5	1.1	0.55	0.22	–	–	OD
TLC372/4	3 – 16	1000	75	5	0.65	0.65	–	–	–	OD

† All specifications are typical values measured at 5 V.

TLV3701 AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES			
		SMALL OUTLINE (D)†	SOT-23 (DBV)‡	SYMBOL	PLASTIC DIP (P)
0°C to 70°C	5000 μV	TLV3701CD	TLV3701CDBV	VBCC	—
-40°C to 125°C		TLV3701ID	TLV3701IDBV	VBCI	TLV3701IP

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV3701CDR).
‡ This package is only available taped and reeled. For standard quantities (3000 pieces per reel), add an R suffix (i.e., TLV3701CDBVR). For small quantities (250 pieces per mini-reel), add a T suffix to the part number (e.g., TLV3701CDBVT).

TLV3702 AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES			
		SMALL OUTLINE (D)†	MSOP (DGK)†	SYMBOL	PLASTIC DIP (P)
0°C to 70°C	5000 μV	TLV3702CD	TLV3702CDGK	xxTIAKC	—
–40°C to 125°C		TLV3702ID	TLV3702IDGK	xxTIAKD	TLV3702IP

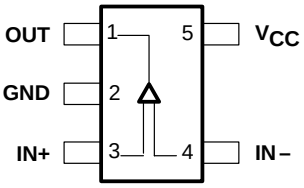
† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV3702CDR).

TLV3704 AVAILABLE OPTIONS

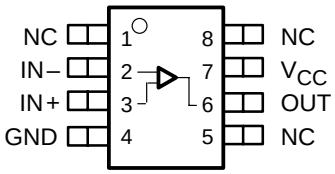
T_A	V_{IO}max AT 25°C	PACKAGED DEVICES		
		SMALL OUTLINE (D)†	PLASTIC DIP (N)	TSSOP (PW)
0°C to 70°C	5000 μV	TLV3704CD	—	TLV3704CPW
–40°C to 125°C		TLV3704ID	TLV3704IN	TLV3704IPW

† This package is available taped and reeled. To order this packaging option, add an R suffix to the part number (e.g., TLV3704CDR).

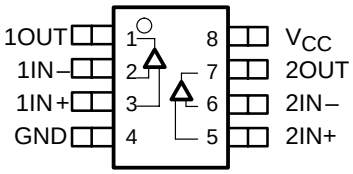
TLV3701
DBV PACKAGE
(TOP VIEW)



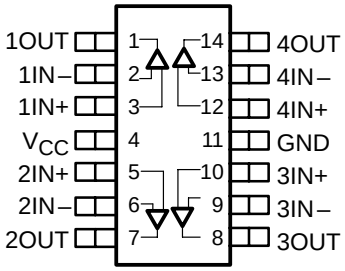
TLV3701
D OR P PACKAGE
(TOP VIEW)



TLV3702
D, DGK, OR P PACKAGE
(TOP VIEW)



TLV3704
D, N, OR PW PACKAGE
(TOP VIEW)



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

Supply voltage, V_{CC} (see Note 1) . . . . . 17 V
Differential input voltage, V_{ID} . . . . . ±20 V
Input voltage range, V_I (see Notes 1 and 2) . . . . . 0 to V_{CC} + 5 V
Input current range, I_I . . . . . ±10 mA
Output current range, I_O . . . . . ±10 mA
Continuous total power dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: C suffix . . . . . 0°C to 70°C
I suffix . . . . . –40°C to 125°C
Maximum junction temperature, T_J . . . . . 150°C
Storage temperature range, T_{stg} . . . . . –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 GND.
2. Input voltage range is limited to 20 V max or V_{CC} + 5 V, whichever is smaller.

DISSIPATION RATING TABLE

PACKAGE	θ_{JC} (°C/W)	θ_{JA} (°C/W)	$T_A \le 25°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D (8)	38.3	176	710 mW	142 mW
D (14)	26.9	122.6	1022 mW	204.4 mW
DBV (5)	55	324.1	385 mW	77.1 mW
DGK (8)	54.2	259.9	481 mW	96.2 mW
N (14)	32	78	1600 mW	320.5 mW
P (8)	41	104	1200 mW	240.4 mW
PW (14)	29.3	173.6	720 mW	144 mW

recommended operating conditions

			MIN	MAX	UNIT
Supply voltage, V_{CC}	Single supply	C-suffix	2.5	16	V
		I-suffix	2.7	16	
	Split supply	C-suffix	±1.25	±8	
		I-suffix	±1.35	±8	
Common-mode input voltage range, V_{ICR}			–0.1	V_{CC}+5	V
Operating free-air temperature, T_A	C-suffix		0	70	°C
	I-suffix		–40	125	

electrical characteristics at specified operating free-air temperature, V_{CC} = 2.7 V, 5 V, 15 V (unless otherwise noted)

dc performance

PARAMETER		TEST CONDITIONS		T_A†	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{IC}= V_{CC}/2,	R_S = 50 Ω	25°C		250	5000	μV
				Full range			7000	
α_{VIO}	Offset voltage drift			25°C		3		μV/°C
CMRR	Common-mode rejection ratio	V_{IC}= 0 to 2.7 V,	R_S = 50 Ω	25°C	55	72		dB
				Full range	50			
		V_{IC}= 0 to 5 V,	R_S = 50 Ω	25°C	60	76		
				Full range	55			
		V_{IC}= 0 to 15 V,	R_S = 50 Ω	25°C	65	88		
				Full range	60			
A_{VD}	Large-signal differential voltage amplification			25°C		1000		V/mV

† Full range is 0°C to 70°C for C suffix and –40°C to 125°C for I suffix. If not specified, full range is –40°C to 125°C.

input/output characteristics

PARAMETER		TEST CONDITIONS		T_A†	MIN	TYP	MAX	UNIT
I_{IO}	Input offset current	V_{IC} = V_{CC}/2,	R_S = 50 Ω	25°C		20	100	pA
				Full range			1000	
I_{IB}	Input bias current			25°C		80	250	pA
				Full range			1500	
$r_{i(d)}$	Differential input resistance			25°C		300		MΩ
V_{OH}	High-level output voltage	V_{IC} = V_{CC}/2,	I_{OH} = 2 μA, V_{ID} = 1 V	25°C		V_{CC}– 0.08		mV
		V_{IC} = V_{CC}/2,	I_{OH} = –50 μA, V_{ID} = 1 V	25°C	V_{CC}– 320			
				Full range	V_{CC}– 450			
V_{OL}	Low-level output voltage	V_{IC} = V_{CC}/2,	I_{OH} = 2 μA, V_{ID} = –1 V	25°C		8		mV
		V_{IC} = V_{CC}/2,	I_{OH} = 50 μA, V_{ID} = –1 V	25°C		80	200	
				Full range			300	

† Full range is 0°C to 70°C for C suffix and –40°C to 125°C for I suffix. If not specified, full range is –40°C to 125°C.

power supply

PARAMETER		TEST CONDITIONS		T_A†	MIN	TYP	MAX	UNIT
I_{CC}	Supply current (per channel)	Output state high		25°C		560	800	nA
				Full range			1000	
PSRR	Power supply rejection ratio	V_{IC} = V_{CC}/2 V, No load	V_{CC}= 2.7 V to 5 V	25°C	75	100		dB
				Full range	70			
			V_{CC}= 5 V to 15 V	25°C	85	105		
				Full range	80			

† Full range is 0°C to 70°C for C suffix and –40°C to 125°C for I suffix. If not specified, full range is –40°C to 125°C.

switching characteristics at recommended operating conditions, V_{CC} = 2.7 V, 5 V, 15 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{(PLH)}$	Propagation response time, low-to-high-level output (see Note 3)	f = 10 kHz, V_{STEP} = 100 mV, C_L = 10 pF, V_{CC} = 2.7 V	Overdrive = 2 mV		240		µs
			Overdrive = 10 mV		64		
			Overdrive = 50 mV		36		
$t_{(PHL)}$	Propagation response time, high-to-low-level output (see Note 3)		Overdrive = 2 mV		167		
			Overdrive = 10 mV		67		
			Overdrive = 50 mV		37		
t_r	Rise time	C_L = 10 pF, V_{CC} = 2.7 V			7		µs
t_f	Fall time	C_L = 10 pF, V_{CC} = 2.7 V			9		µs

NOTE 3: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V. Propagation responses are longer at higher supply voltages, refer to Figures 12–17 for further details.

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
	Input bias/offset current	vs Free-air temperature	1
	Open collector leakage current	vs Free-air temperature	2
V_{OL}	Low-level output voltage	vs Low-level output current	3, 5, 7
V_{OH}	High-level output voltage	vs High-level output current	4, 6, 8
I_{CC}	Supply current	vs Supply voltage	9
		vs Free-air temperature	10
	Output fall time/rise time	vs Supply voltage	11
	Low-to-high level output response for various input overdrives		12, 14, 16
	High-to-low level output response for various input overdrives		13, 15, 17

INPUT BIAS/OFFSET CURRENT vs FREE-AIR TEMPERATURE

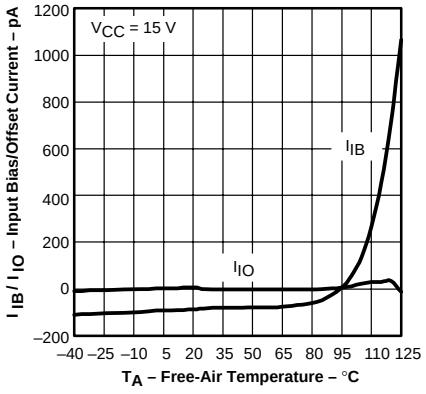


Figure 1

OPEN COLLECTOR LEAKAGE CURRENT vs FREE-AIR TEMPERATURE

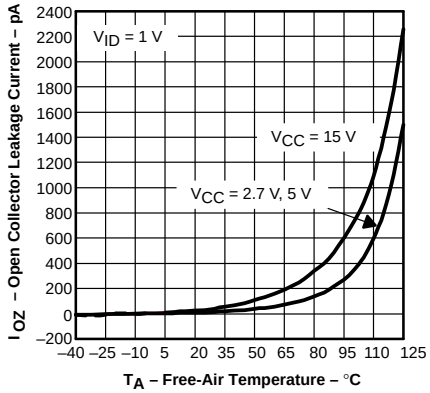


Figure 2

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

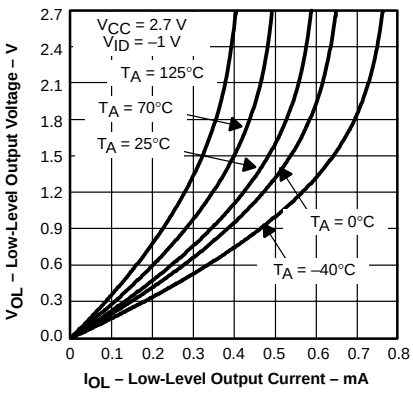


Figure 3

TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

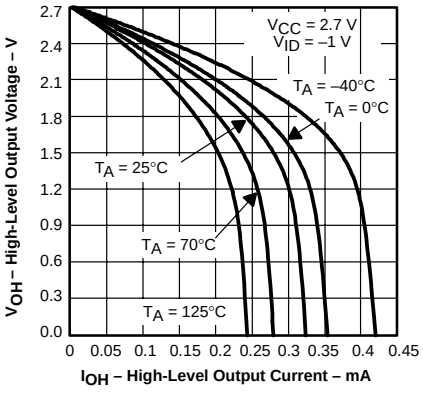


Figure 4

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

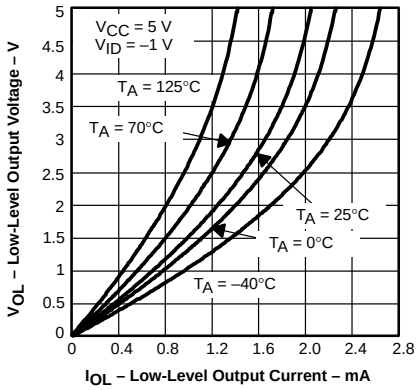


Figure 5

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

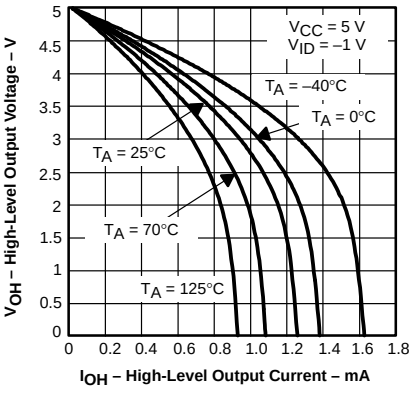


Figure 6

LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

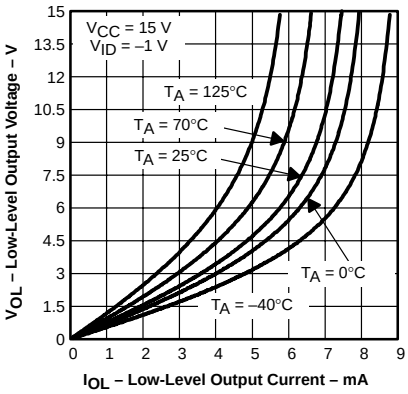


Figure 7

HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT

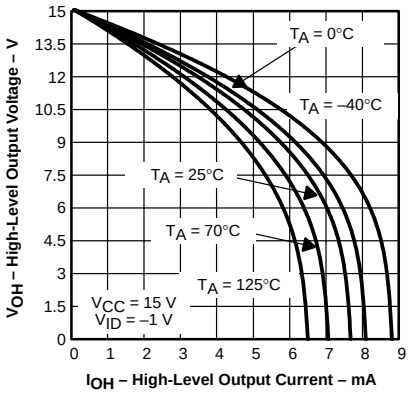


Figure 8

SUPPLY CURRENT vs SUPPLY VOLTAGE

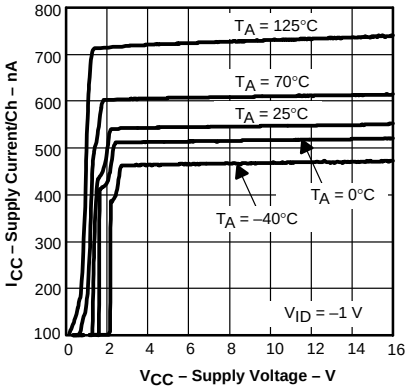


Figure 9

SUPPLY CURRENT vs FREE-AIR TEMPERATURE

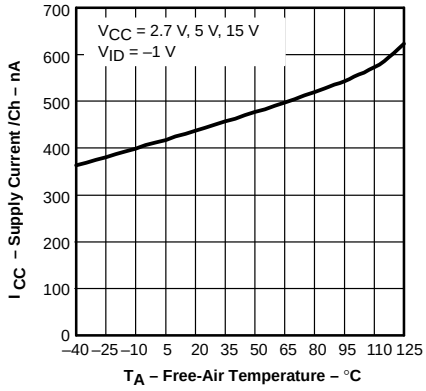


Figure 10

OUTPUT RISE/FALL TIME vs SUPPLY VOLTAGE

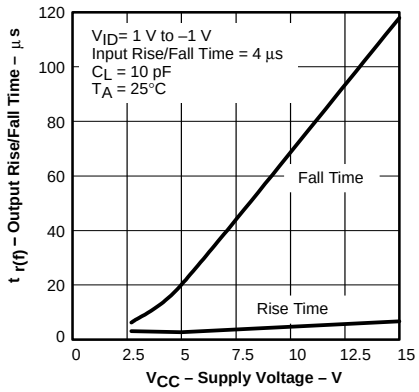


Figure 11

TYPICAL CHARACTERISTICS

LOW-TO-HIGH OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

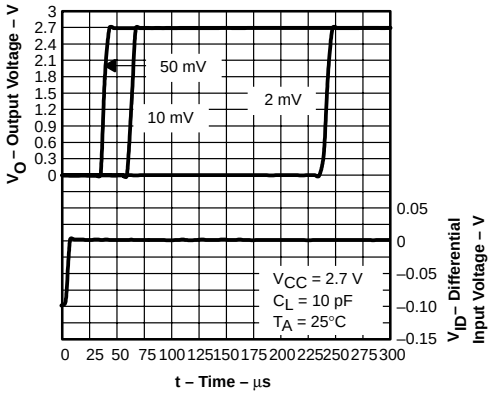


Figure 12

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

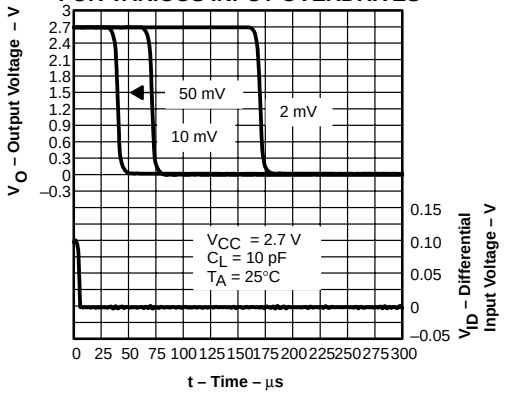


Figure 13

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

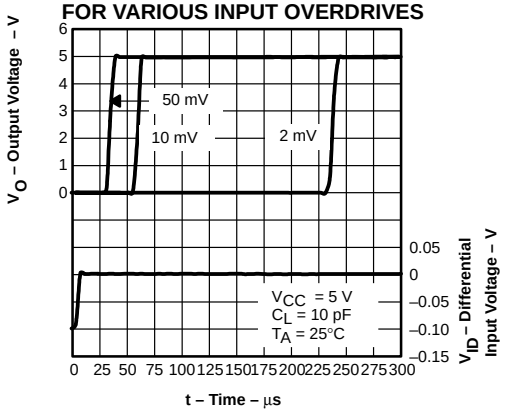


Figure 14

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

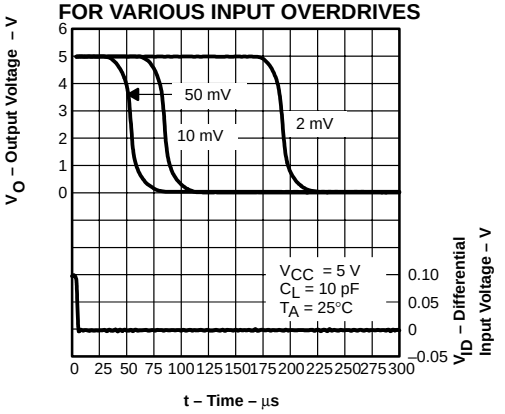


Figure 15

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

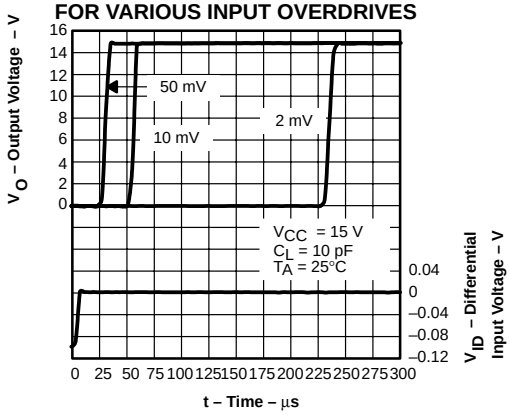


Figure 16

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

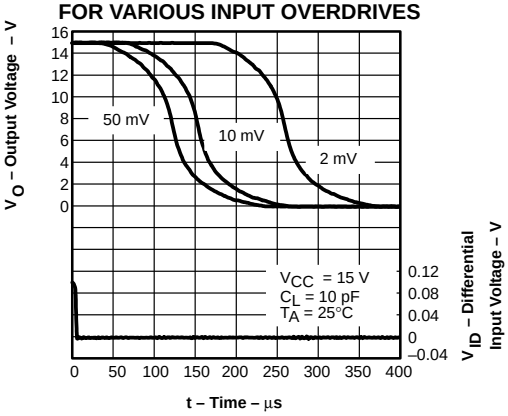
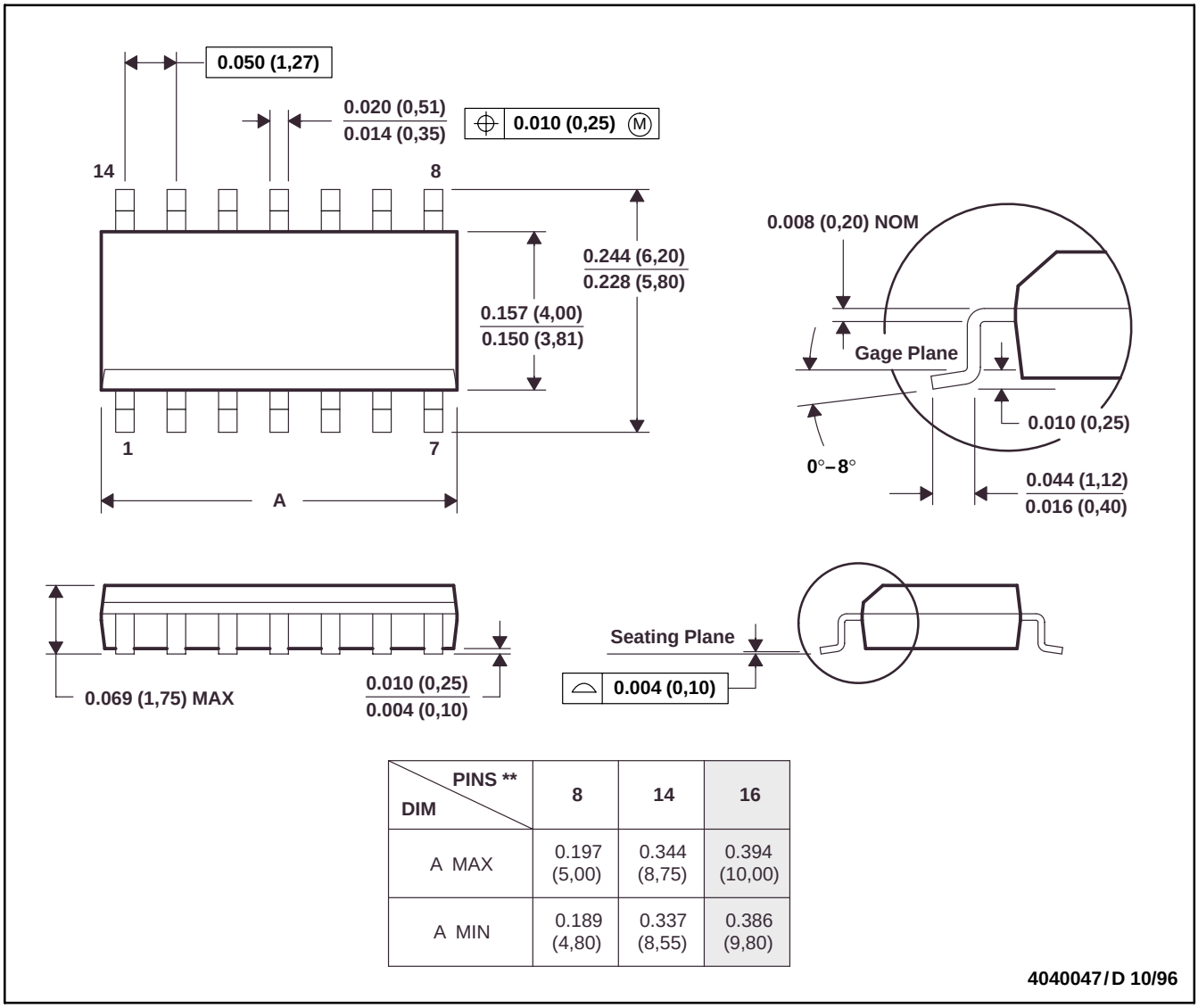


Figure 17

MECHANICAL DATA

D (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

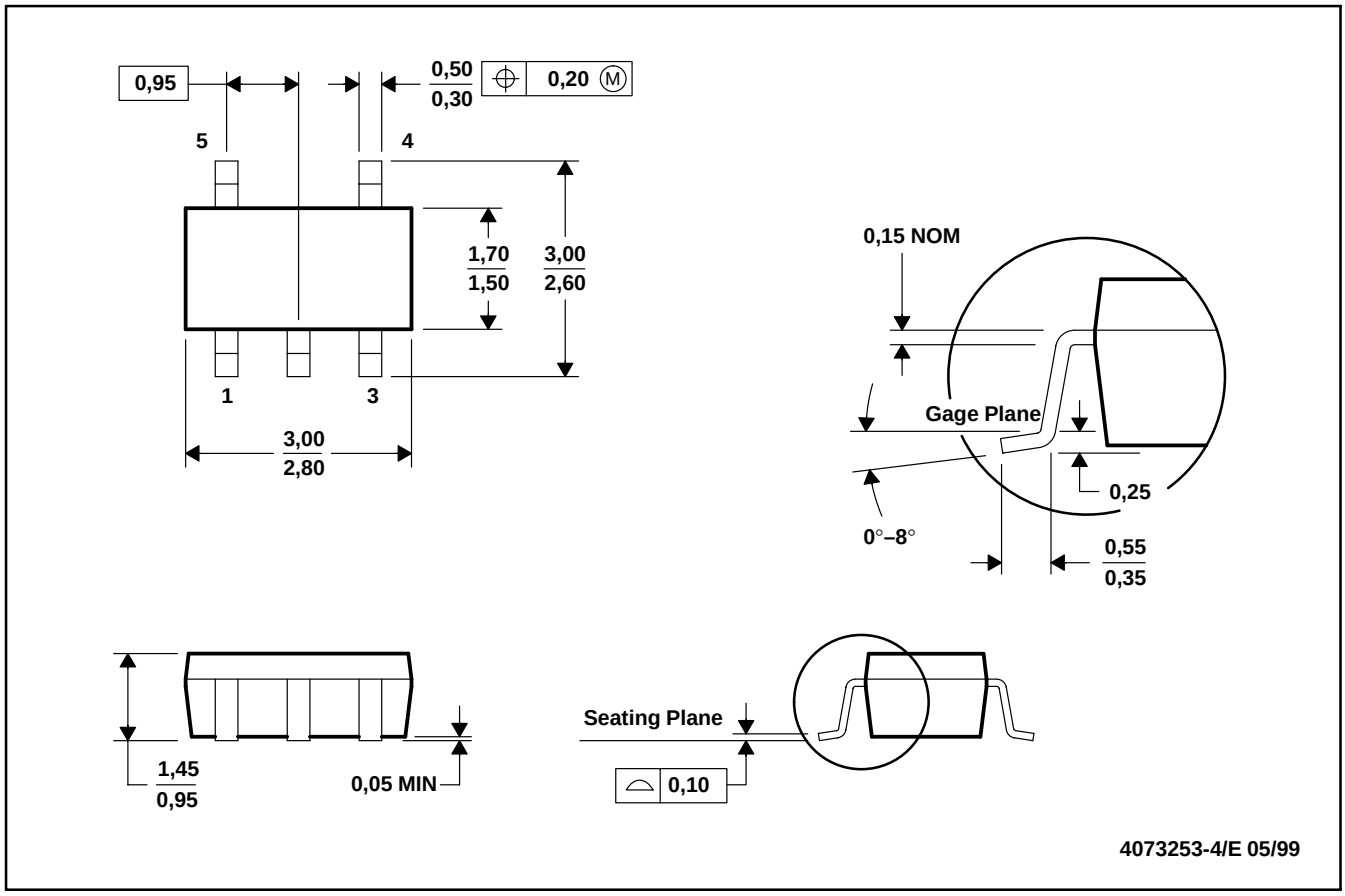
4040047/D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

MECHANICAL DATA

DBV (R-PDSO-G5) **PLASTIC SMALL-OUTLINE**

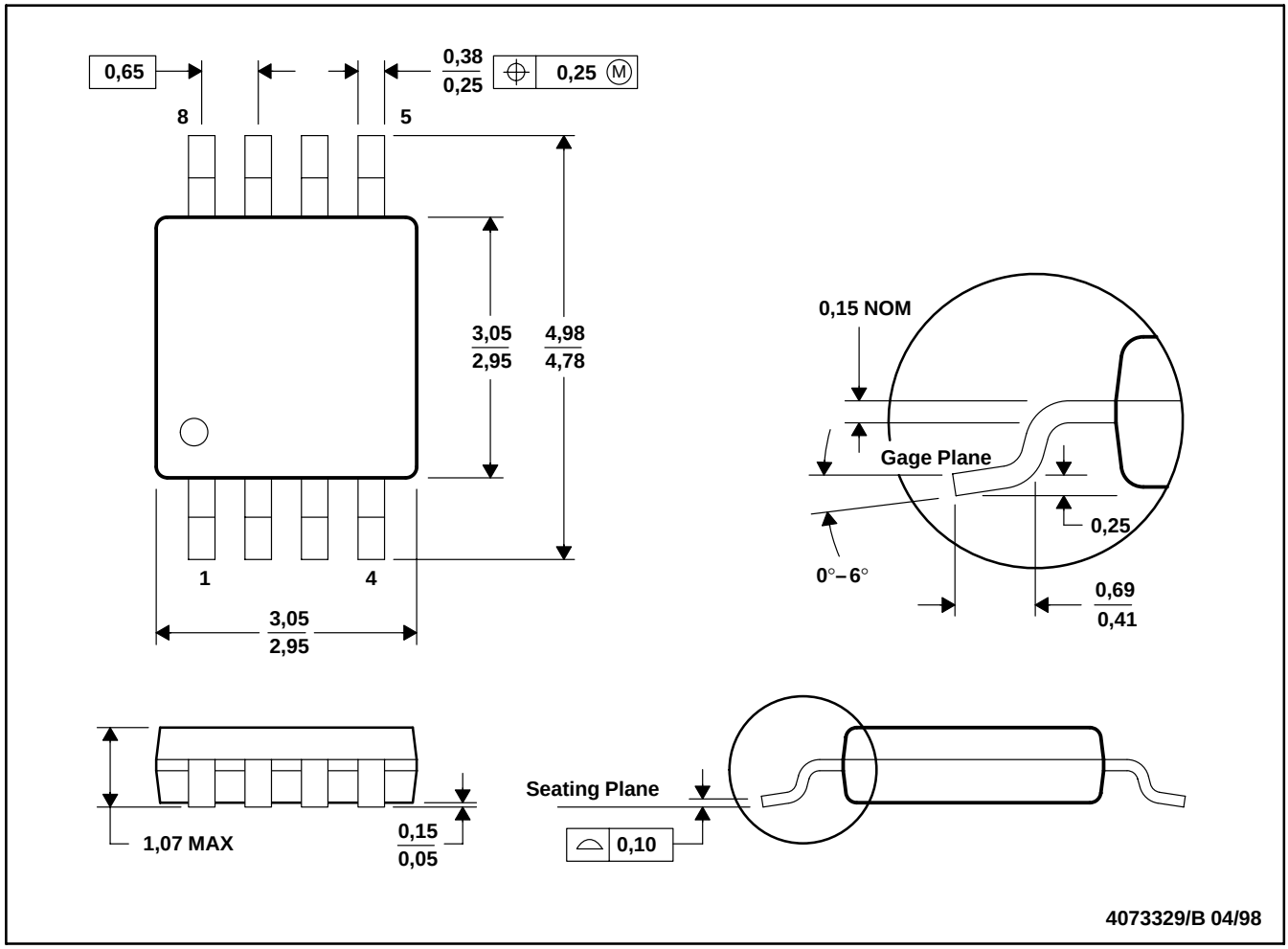


NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-178

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

MECHANICAL DATA

DGK (R-PDSO-G8) **PLASTIC SMALL-OUTLINE PACKAGE**



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO-187

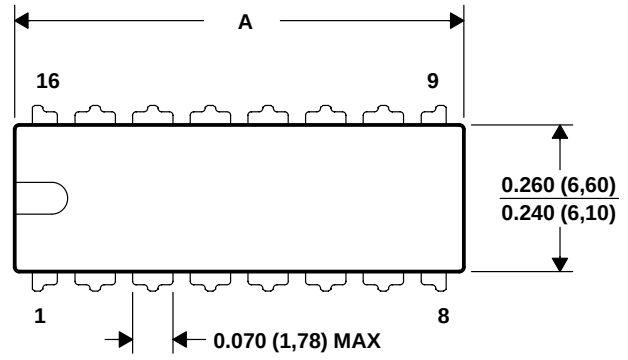
For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

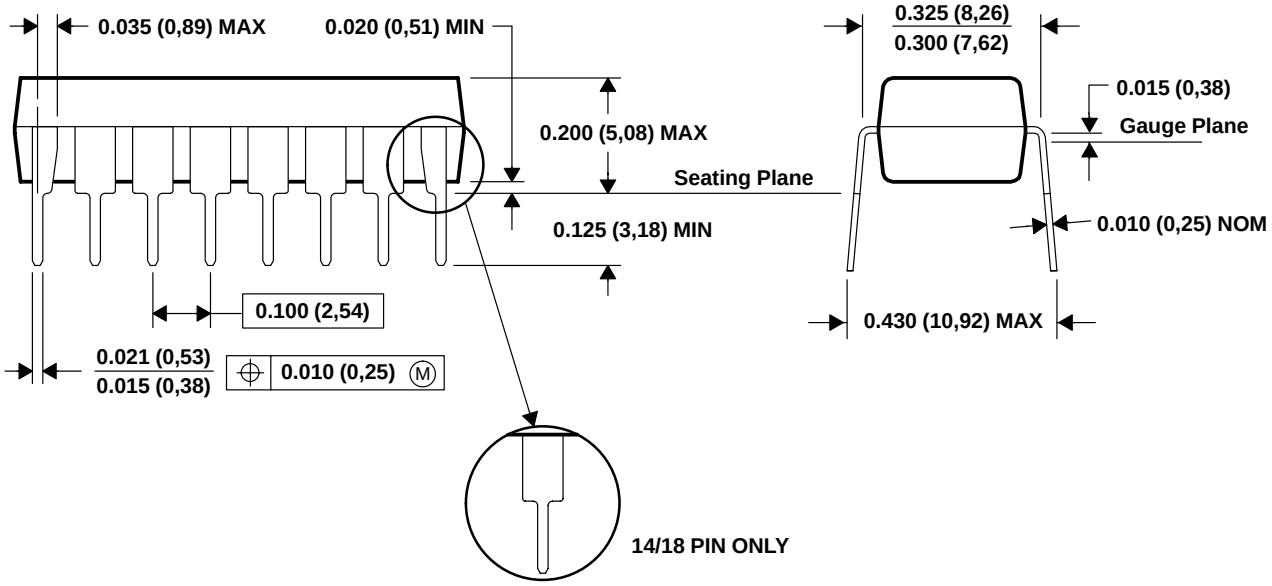
MECHANICAL DATA

N (R-PDIP-T)** **PLASTIC DUAL-IN-LINE PACKAGE**

16 PINS SHOWN

DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	0.975 (24,77)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)





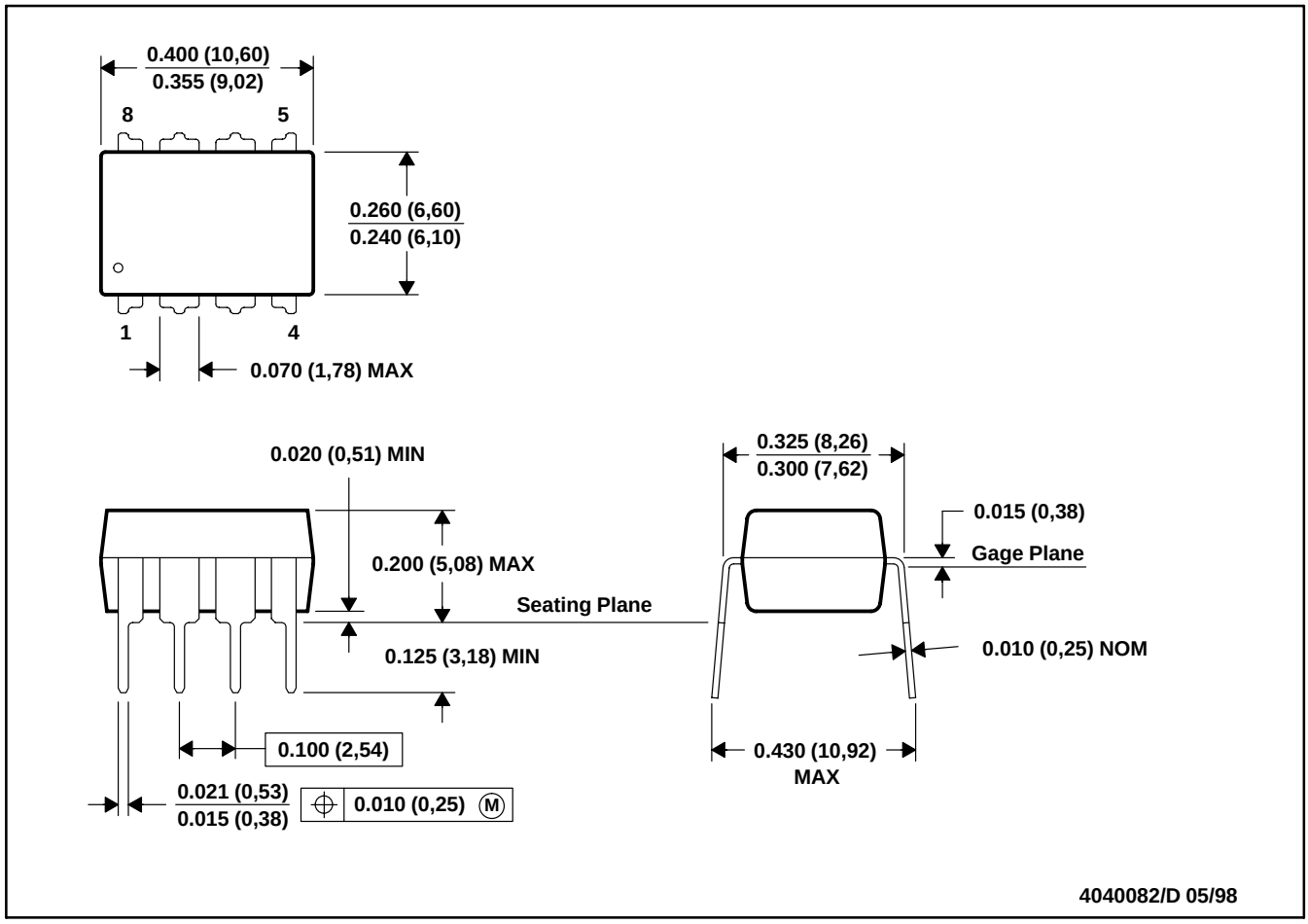
4040049/D 02/00

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 (20-pin package is shorter than MS-001).

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

MECHANICAL DATA

P (R-PDIP-T8) **PLASTIC DUAL-IN-LINE**



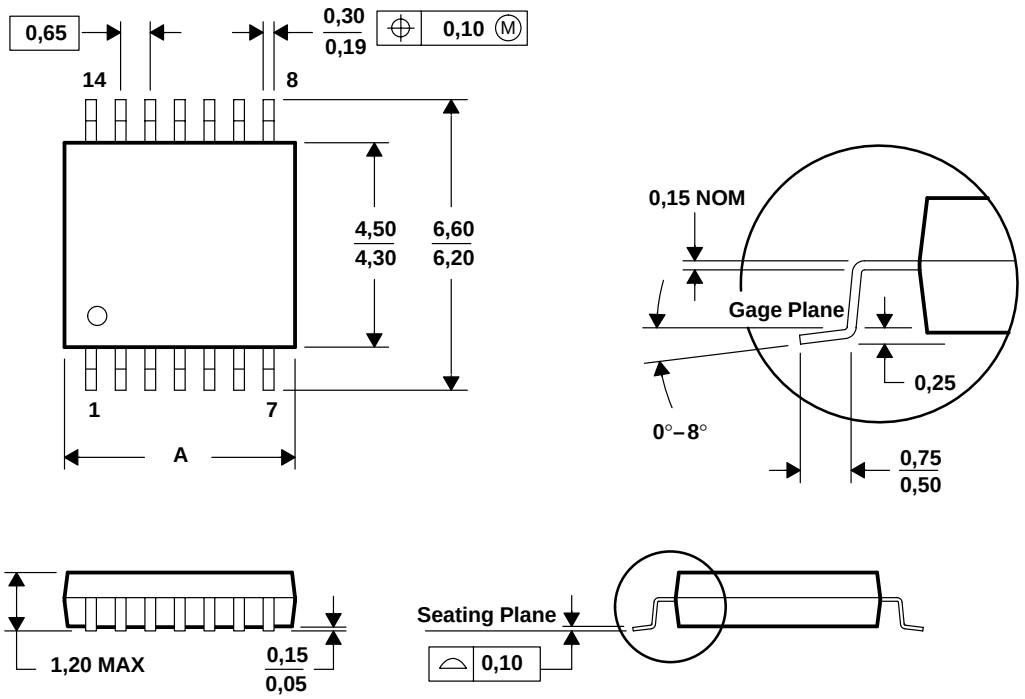
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

MECHANICAL DATA

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

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