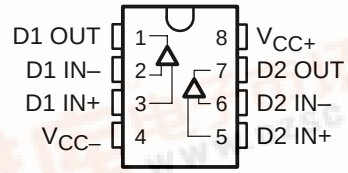
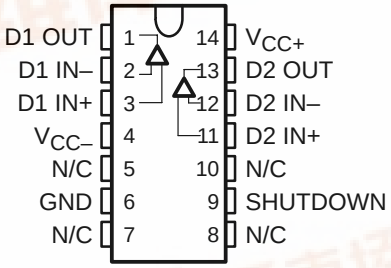
SLOS293D – JUNE 2000 – REVISED DECEMBER 2001

- **Remote Terminal ADSL Line Driver**
  - **Ideal for Both Full Rate ADSL and G.Lite**
  - **Compatible With 1:1 Transformer Ratio**
- **Low 2.7 pA/√Hz Noninverting Current Noise**
  - **Reduces Noise Feedback Through Hybrid Into Downstream Channel**
- **Wide Supply Voltage Range ±5 V to ±15 V**
  - **Ideal for ±12-V Operation**
- **Wide Output Swing**
  - **42 Vpp Differential Output Voltage, R_L = 200 Ω, ±12-V Supply**
- **High Output Current**
  - **175 mA (typ)**
- **High Speed**
  - **110 MHz (–3 dB, G=8, ±12 V)**
  - **1500 V/μs Slew Rate (G = 8, ±12 V)**
- **Low Distortion, Single-Ended, G = 8**
  - **–83 dBc (250 kHz, 2 Vpp, 100-Ω load)**
- **Low Power Shutdown (THS6053)**
  - **300-μA Total Standby Current**
- **Thermal Shutdown and Short Circuit Protection**
- **Standard SOIC, SOIC PowerPAD, and TSSOP PowerPAD™ Package**
- **Evaluation Module Available**

THS6052
SOIC (D) AND
SOIC PowerPAD™ (DDA) PACKAGE
(TOP VIEW)

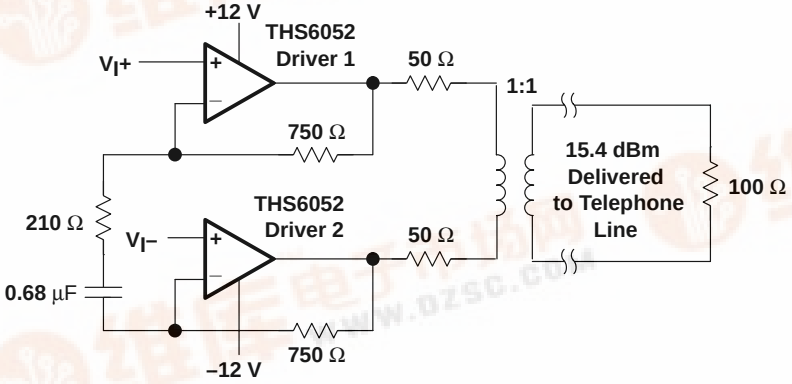


THS6053
SOIC (D) AND
TSSOP PowerPAD™ (PWP) PACKAGE
(TOP VIEW)



description

The THS6052/3 is a high-speed line driver ideal for driving signals from the remote terminal to the central office in asymmetrical digital subscriber line (ADSL) applications. It can operate from ±12-V supply voltages while drawing only 5.2 mA of supply current per channel. It offers low –83 dBc total harmonic distortion driving a 100-Ω load (2 Vpp). The THS6052/3 offers a high 42-Vpp differential output swing across a 200-Ω load from a ±12-V supply. The THS6053 features a low-power shutdown mode, consuming only 300 μA quiescent current per channel. The THS6052/3 is packaged in a standard SOIC, SOIC PowerPAD™, and TSSOP PowerPAD™ packages.



RELATED PRODUCTS

DEVICE	DESCRIPTION
THS6042/3	350-mA, ±12 ADSL CPE line driver
THS6092/3	275-mA, +12 V ADSL CPE line driver
OPA2677	380-mA, +12 V ADSL CPE line driver
THS6062	Low noise ADSL receiver

AVAILABLE OPTION

T_A	PACKAGED DEVICE				EVALUATION MODULES
	SOIC-8 (D)	SOIC-8 PowerPAD (DDA)	SOIC-14 (D)	TSSOP-14 (PWP)	
0°C to 70°C	THS6052CD	THS6052CDDA	THS6053CD	THS6053CPWP	THS6052EVM THS6053EVM
–40°C to 85°C	THS6052ID	THS6052IDDA	THS6053ID	THS6053IPWP	—

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

Supply voltage, V_{CC+} to V_{CC-} . . . . . 33 V
Input voltage . . . . . ± V_{CC}
Output current (see Note 1) . . . . . 275 mA
Differential input voltage . . . . . ± 4 V
Maximum junction temperature . . . . . 150°C
Total power dissipation at (or below) 25°C free-air temperature . . . . . See Dissipation Ratings Table
Operating free-air temperature, T_A: Commercial . . . . . 0°C to 70°C
Industrial . . . . . –40°C to 85°C
Storage temperature, T_{stg} : Commercial . . . . . –65°C to 125°C
Industrial . . . . . –65°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 300°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.

NOTE 1: The THS6052 and THS6053 may incorporate a PowerPAD™ on the underside of the chip. This acts as a heatsink and must be connected to a thermally dissipating plane for proper power dissipation. Failure to do so may result in exceeding the maximum junction temperature which could permanently damage the device. See TI technical brief SLMA002 for more information about utilizing the PowerPAD™ thermally enhanced package.

DISSIPATION RATING TABLE

PACKAGE	θ_{JA}	θ_{JC}	T_A = 25°C T_J = 150°C POWER RATING
D-8	95°C/W‡	38.3°C/W‡	1.32 W
DDA	45.8°C/W‡	9.2°C/W‡	2.73 W
D-14	66.6°C/W‡	26.9°C/W‡	1.88 W
PWP	37.5°C/W	1.4°C/W	3.3 W

‡ This data was taken using the JEDEC proposed high-K test PCB. For the JEDEC low-K test PCB, the Θ_{JA} is168°C/W for the D–8 package and 122.3°C/W for the D–14 package.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC+} to V_{CC-}	Dual supply	±5		±15	V
	Single supply	10		30	
Operating free-air temperature, T_A	C-suffix	0		70	°C
	I-suffix	–40		85	

electrical characteristics over recommended operating free-air temperature range, T_A = 25°C, V_{CC} = ±12 V, $R_{FEEDBACK}$ = 750 Ω, R_L = 100 Ω (unless otherwise noted)

dynamic performance

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
BW	Small-signal bandwidth (–3 dB)	R_L = 50 Ω	G= 1, R_F = 1 kΩ	V_{CC} = ±5 V		110		MHz
				V_{CC} = ±12 V		120		
			G= 2, R_F = 680 Ω	V_{CC} = ±5 V, ±12 V		100		
			G= 8, R_F = 330 Ω			90		
		R_L = 100 Ω	G= 1, R_F = 1 kΩ	V_{CC} = ±5 V		150		
				V_{CC} = ±12 V		170		
			G= 2, R_F = 680 Ω	V_{CC} = ±5 V, ±12 V		135		
			G= 8, R_F = 330 Ω			110		
SR	Slew rate (see Note 2), G=8	V_O = 4 V_{PP}	V_{CC} = ±5 V	V_{CC} = ±5 V		650		V/µs
			V_{CC} = ±12 V	V_{CC} = ±12 V		850		
			V_{CC} = ±15 V	V_{CC} = ±15 V		950		
		V_O = 16 V_{PP}	V_{CC} = ±12 V	V_{CC} = ±12 V		1500		
			V_{CC} = ±15 V	V_{CC} = ±15 V		1700		

NOTE 2: Slew rate is defined from the 25% to the 75% output levels.

noise/distortion performance

PARAMETER			TEST CONDITIONS			MIN	TYP	MAX	UNIT
THD	Total harmonic distortion (single-ended configuration)		Gain = 8, V_{CC} = ±12 V,	R_L = 100 Ω, f = 250 kHz	$V_{O(pp)}$ = 2 V		–83		dBc
					$V_{O(pp)}$ = 16 V		–78		
			Gain = 8, V_{CC} = ±5 V,	R_L = 50 Ω, f = 250 kHz	$V_{O(pp)}$ = 2 V		–74		
					$V_{O(pp)}$ = 6 V		–72		
V_n	Input voltage noise		V_{CC} = ±5 V, ±12 V	f = 10 kHz ,			2.1		nV/√Hz
I_n	Input current noise	+Input	f = 10 kHz,	V_{CC} = ±5 V, V_{CC} = ±12 V, V_{CC} = ±15 V			2.7		pA/√Hz
		–Input					10.7		
X_T	Crosstalk		f = 250 kHz, G = 2,	V_{CC} = ±12 V, R_L= 100 Ω	V_O = 2 Vp-p		–79		dBc
			f = 250 kHz, G = 2,	V_{CC} = ±5 V, R_L= 50 Ω	V_O = 2 Vp-p		–71		

electrical characteristics over recommended operating free-air temperature range, T_A = 25°C, V_{CC} = ±12 V, $R_{FEEDBACK}$ = 750 Ω, R_L = 100 Ω (unless otherwise noted) (continued)

dc performance

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OS}	Input offset voltage	V_{CC} = ±12 V, V_{CC} = ±6 V	T_A = 25°C		5	10	mV
			T_A = full range			15	
	Differential offset voltage		T_A = 25°C		3	6	
			T_A = full range			8	
	Offset drift		T_A = full range			30	µV/°C
I_{IB}	– Input bias current	V_{CC} = ±12 V, V_{CC} = ±6 V	T_A = 25°C		5	10	µA
			T_A = full range			12	
	+ Input bias current		T_A = 25°C		2	5	
			T_A = full range			6	
	Differential input bias current		T_A = 25°C		5	10	
			T_A = full range			12	
Z_{OL}	Open loop transimpedance	V_{CC} = ±12 V, V_{CC} = ±6 V	R_L = 1 kΩ,		1		MΩ

input characteristics

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{ICR}	Input common-mode voltage range	V_{CC} = ±12 V		±9.7	±10.1		V
		V_{CC} = ±6 V		±3.8	±4.2		
CMRR	Common-mode rejection ratio	V_{CC} = ±12 V, V_{CC} = ±6 V	T_A = 25°C	59	66		dB
			T_A = full range	57			
R_I	Input resistance	+ Input			1.5		MΩ
		– Input			15		Ω
C_I	Input capacitance				2		pF

output characteristics

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage swing	Single ended	R_L = 50 Ω,	V_{CC} = ± 6 V	±4.2	±4.6		V
			R_L = 100 Ω	V_{CC} = ±12 V	±10.1	±10.5		
				V_{CC} = ±6 V	±4.4	±4.8		
I_O	Output current		R_L = 25 Ω,	V_{CC} = ±12 V	150	175		mA
			R_L = 10 Ω,	V_{CC} = ±6 V	150	175		
I_{SC}	Short-circuit current		R_L = 0 Ω,	V_{CC} = ±12 V		250		mA
	Output resistance		Open loop			14		Ω

electrical characteristics over recommended operating free-air temperature range, T_A = 25°C, V_{CC} = ±12 V, $R_{FEEDBACK}$ = 750 Ω, R_L = 100 Ω (unless otherwise noted) (continued)

power supply

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{CC}	Operating range	Dual supply			±4.5		±16.5	V
		Single supply			9		33	
I_{CC}	Quiescent current (each driver)		V_{CC} = ±12 V	T_A = 25°C		5.2	7	mA
				T_A = full range			8	
			V_{CC} = ±6 V	T_A = 25°C		4.5	6.5	
				T_A = full range			7.5	
PSRR	Power supply rejection ratio		V_{CC} = ±12 V	T_A = 25°C	–64	–62		dB
				T_A = full range	–61	–		
			V_{CC} = ±6 V	T_A = 25°C	–60	–70		
				T_A = full range	–58			

shutdown characteristics (THS6053 only)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{IL(SHDN)}$	Shutdown pin voltage for power up	V_{CC} = ±6 V, ±12 V GND = 0 V, (GND Pin as Reference)			0.8	V
$V_{IH(SHDN)}$	Shutdown pin voltage for power down	V_{CC} = ±6 V, ±12 V, GND = 0 V, (GND Pin as Reference)	2			V
$I_{CC(SHDN)}$	Total quiescent current when in shutdown state	V_{GND} = 0 V, V_{CC} = ±6 V, ±12 V		0.3	0.7	mA
t_{DIS}	Disable time (see Note 3)	V_{CC} = ±12 V		0.1		µs
t_{EN}	Enable time (see Note 3)	V_{CC} = ±12 V		0.4		µs
$I_{IL(SHDN)}$	Shutdown pin input bias current for power up	V_{CC} = ±6 V, ±12 V		40	100	µA
$I_{IH(SHDN)}$	Shutdown pin input bias current for power down	V_{CC} = ±6 V, ±12 V, $V_{(SHND)}$ = 3.3 V		50	100	µA

NOTE 3: Disable/enable time is defined as the time from when the shutdown signal is applied to the SHDN pin to when the supply current has reached half of its final value.

APPLICATION INFORMATION

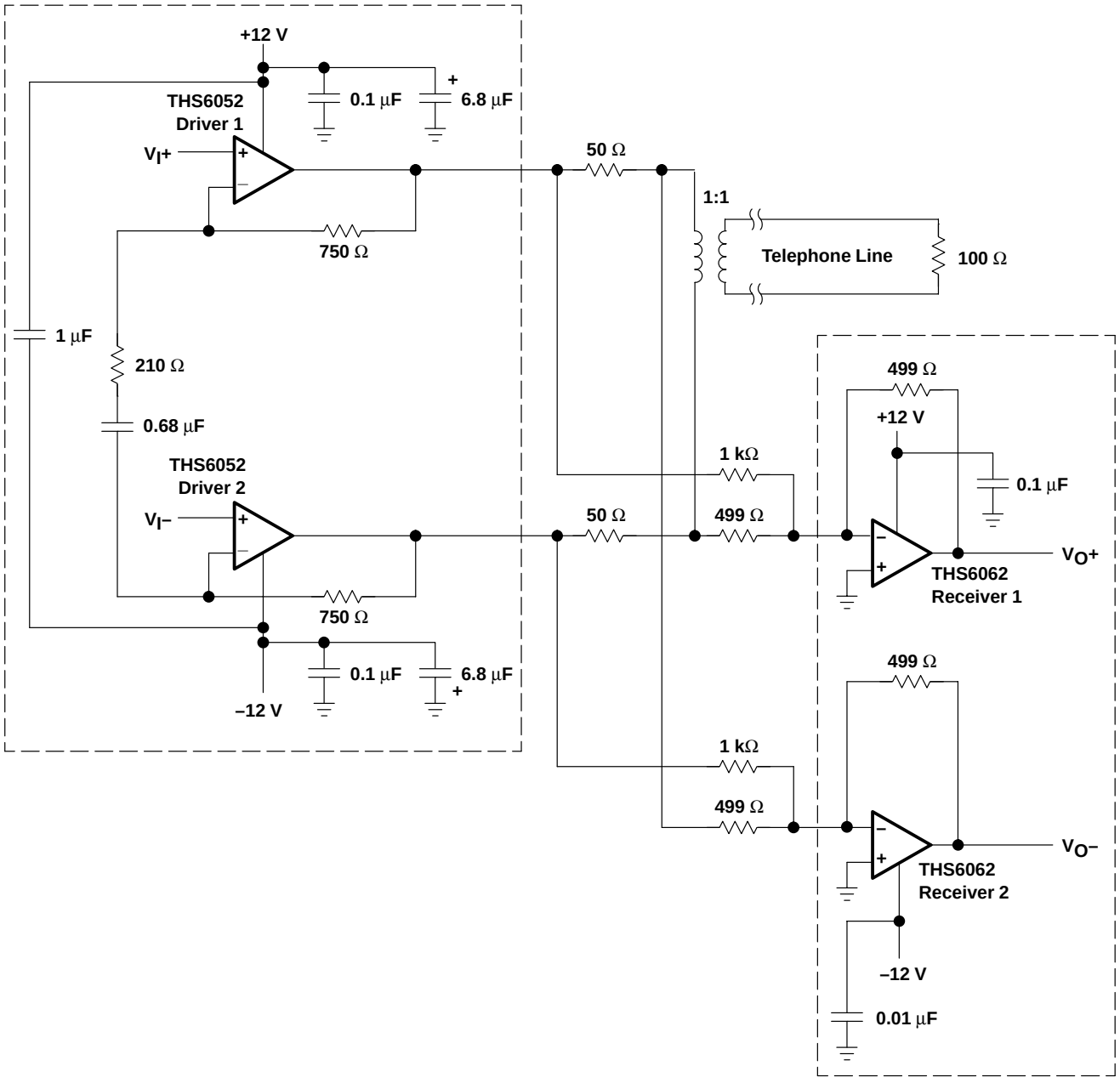
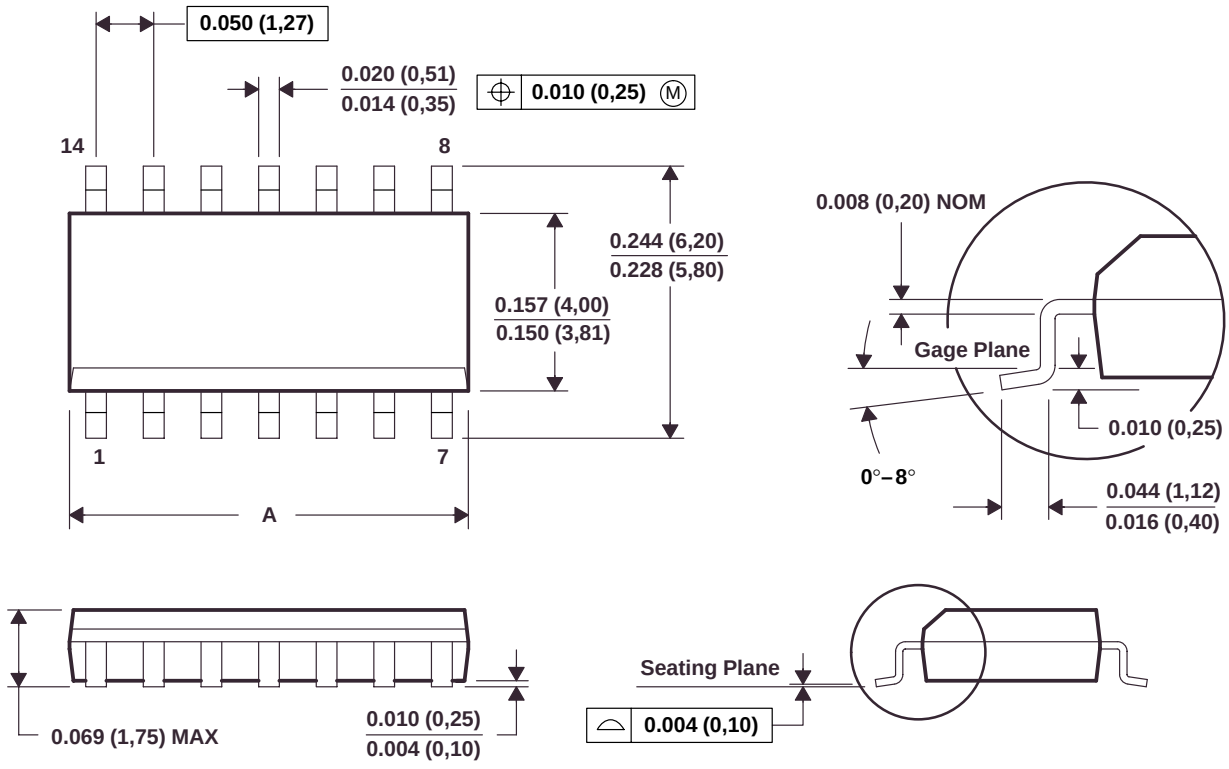


Figure 1. THS6052 ADSL Application With 1:1 Transformer Ratio

MECHANICAL DATA

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

14 PINS SHOWN



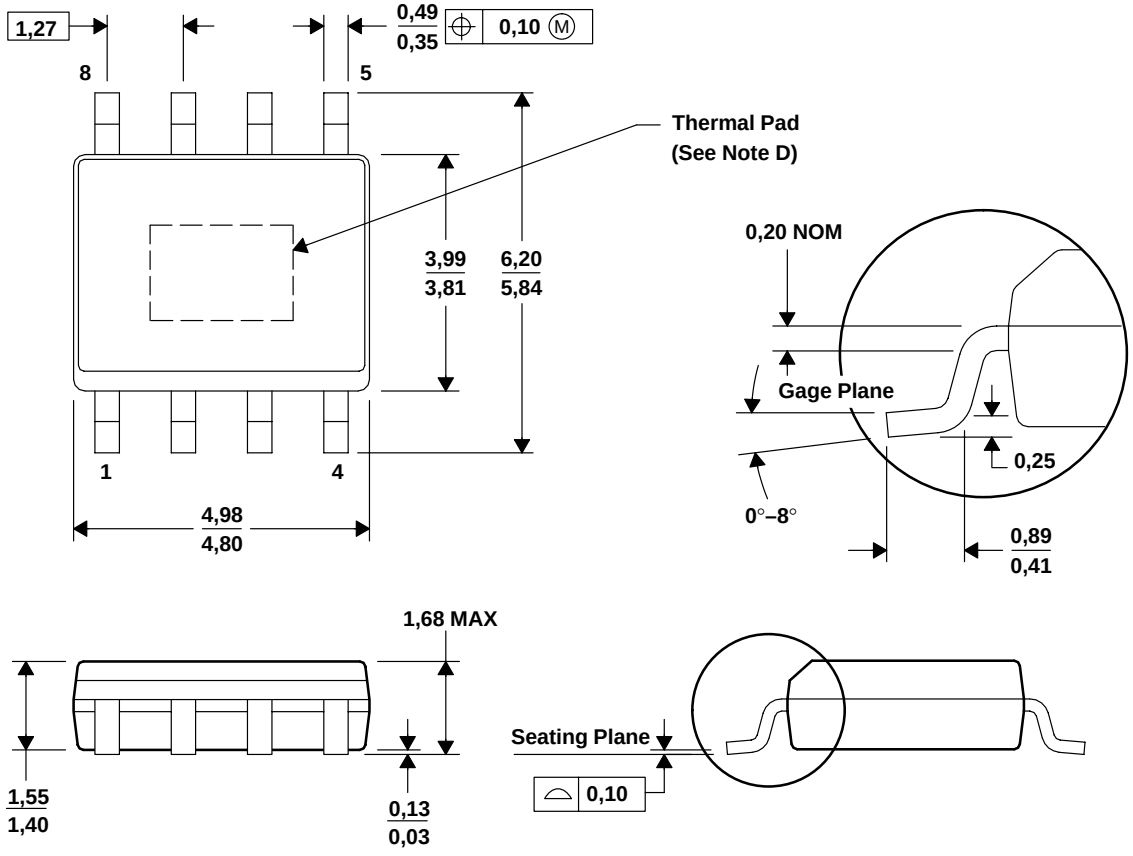
DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

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

MECHANICAL DATA

DDA (S–PDSO–G8) **Power PAD™ PLASTIC SMALL-OUTLINE**



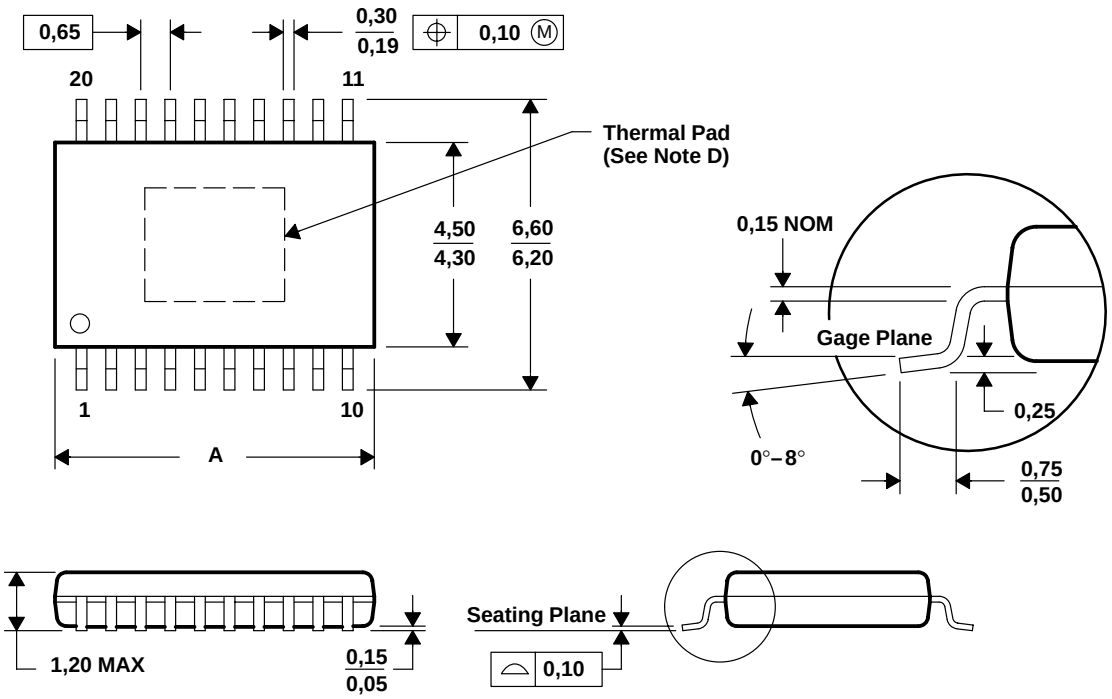
NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. The package thermal performance may be enhanced by bonding the thermal pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected leads.

PowerPAD is a trademark of Texas Instruments.

MECHANICAL INFORMATION

PWP (R-PDSO-G)** **PowerPAD™ PLASTIC SMALL-OUTLINE PACKAGE**

20-PIN SHOWN



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

4073225/E 03/97

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 protrusions.
D. The package thermal performance may be enhanced by bonding the thermal pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected leads.
E. Falls within JEDEC MO-153

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