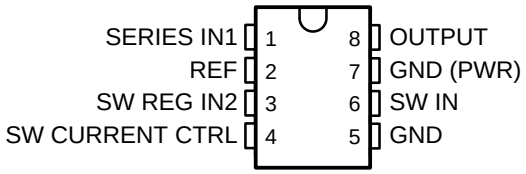
SLVS029G – JANUARY 1984 – REVISED SEPTEMBER 2001

- **Internal Series-Pass and Step-Up Switching Regulator**
- **Output Adjustable From 2.9 V to 30 V**
- **1-V to 10-V Input for Switching Regulator**
- **4.5-V to 32-V Input for Series Regulator**
- **Externally Controlled Switching Current**
- **No External Rectifier Required**

P OR PS PACKAGE
(TOP VIEW)



description

The TL499A is an integrated circuit designed to provide a wide range of adjustable regulated supply voltages. The regulated output voltage can be varied from 2.9 V to 30 V by adjusting two external resistors. When the TL499A is ac-coupled to line power through a step-down transformer, it operates as a series dc voltage regulator to maintain the regulated output voltage. With the addition of a battery from 1.1 V to 10 V, an inductor, a filter capacitor, and two resistors, the TL499A operates as a step-up switching regulator during an ac-line failure.

The adjustable regulated output voltage makes the TL499A useful for a wide range of applications. Providing backup power during an ac-line failure makes the TL499A extremely useful in microprocessor memory applications.

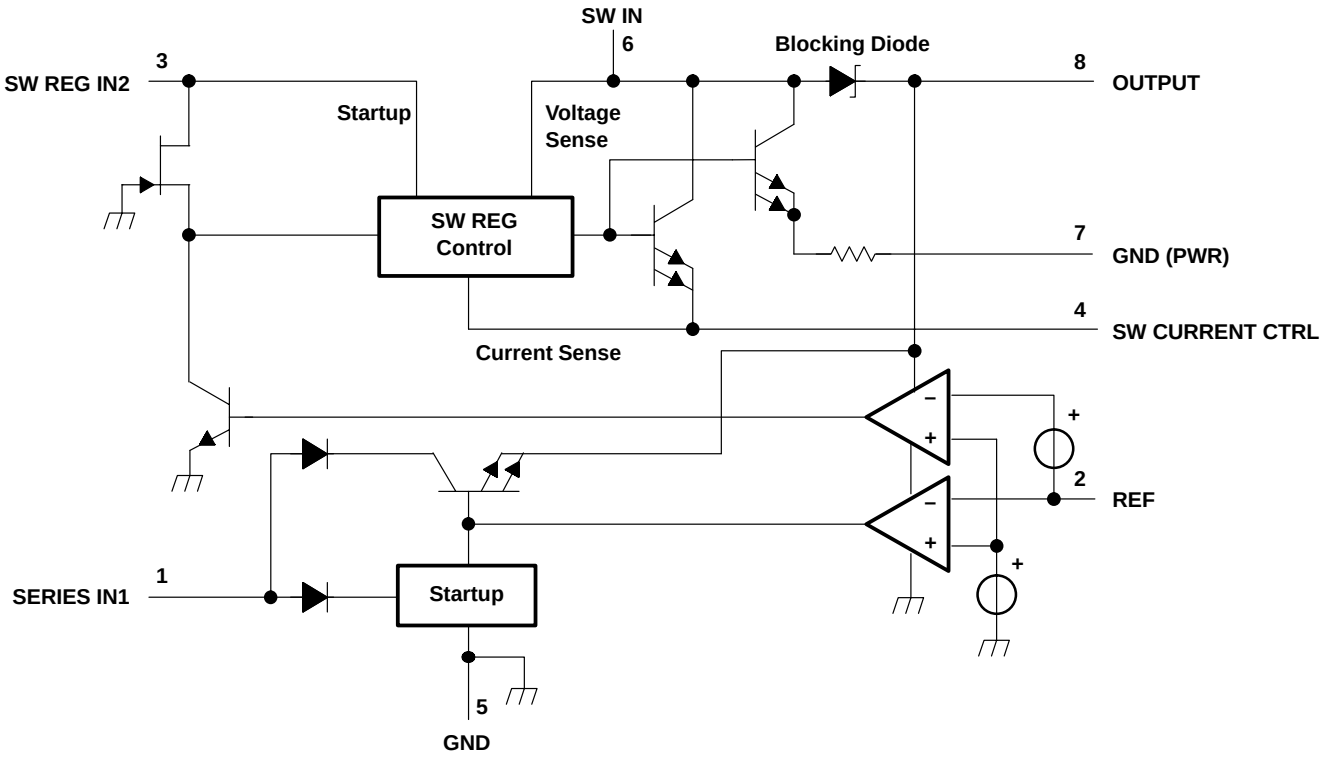
The TL499AC is characterized for operation from –20°C to 85°C.

AVAILABLE OPTIONS

T_A	PLASTIC DIP (P)	PLASTIC SMALL-OUTLINE (PS)
–20°C to 85°C	TL499ACP	TL499ACPS

The PS package is available taped and reeled. Add the suffix R to device type (e.g., TL499ACPSR).

functional block diagram



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

Output voltage, V_O (see Note 1)	35 V
Input voltage, series regulator, V_I1	35 V
Input voltage, switching regulator, V_I2	10 V
Blocking-diode reverse voltage	35 V
Blocking-diode forward current	1 A
Power switch current (SW IN)	1 A
Package thermal impedance, θ_{JA} (see Notes 2 and 3): P package	85°C/W
PS package	95°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{stg}	–65°C to 150°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 are with respect to network ground terminal.
2. Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Output voltage, V_O	2.9		30	V
Input voltage, V_I1 (SERIES IN1)	4.5		32	V
Input voltage, V_I2 (SW REG IN2)	1.1		10	V
Output-to-input differential voltage, switching regulator, $V_O - V_I2$ (see Note 4)	1.2		28.9	V
Continuous output current, I_O			100	mA
Power switch current (at SW IN)			500	mA
Current-limiting resistor, R_{CL}	150		1000	Ω
Filter capacitor	100		470	μF
Pass capacitor		0.1		μF
Inductor, L (dcr ≤ 0.1 Ω)	50		150	μH
Operating free-air temperature, T_A	–20		85	°C

NOTE 4: When operating temperature range is $T_A \le 70°C$, minimum $V_O - V_I2$ is ≥ 1.2 V. When operating temperature range is $T_A \le 85°C$, minimum $V_O - V_I2$ is ≥ 1.9 V.

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TL499AC			UNIT
			MIN	TYP	MAX	
Voltage deviation (see Note 5)				20	30	mV/V
$V_O - V_I2$	Switching regulator	T_A = –20°C to 70°C	1.2			V
		T_A = –20°C to 85°C	1.9			
Dropout voltage	Series regulator	V_I1 = 15 V, I_O = 50 mA			1.8	
Reference voltage (internal)		V_I1 = 5 V, V_O = 3 V, I_O = 1 mA	1.2	1.26	1.32	V
Reference-voltage change with temperature				5	10	mV/V
Output regulation (of reference voltage)		I_O = 1 mA to 50 mA		10	30	mV/V
Output current (see Figure 1)	Switching regulator	V_I2 = 1.1 V, V_O = 12 V, R_{CL} = 150 Ω, T_A = 25°C			10	mA
		V_I2 = 1.5 V, V_O = 15 V, R_{CL} = 150 Ω, T_A = 25°C			15	
		V_I2 = 6 V, V_O = 30 V, R_{CL} = 150 Ω, T_A = 25°C			65	
	Series regulator				100	
Standby current	Switching regulator	V_I2 = 3 V, V_O = 9 V, T_A = 25°C		15	80	μA
	Series regulator	V_I1 = 15 V, V_O = 9 V, R_E2 = 4.7 kΩ		0.8	1.2	mA

NOTE 5: Voltage deviation is the output voltage difference that occurs in a change from series regulation to switching regulation:

$$\text{Voltage deviation} = V_O(\text{series regulation}) - V_O(\text{switching regulation})$$

APPLICATION INFORMATION

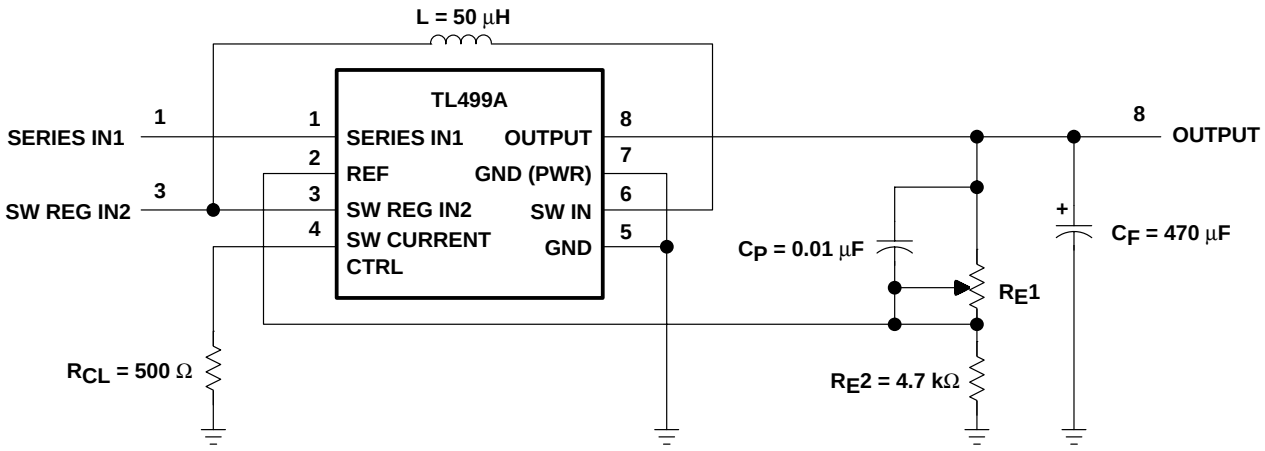


Figure 1. TL499A Basic Configuration

Table 1. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 150 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										65	90
25									50	80	100
20						20	25	30	80	100	100
15				15	20	30	45	55	100	100	100
12	10	15	20	25	30	40	55	70	100	100	100
10	15	20	25	30	35	45	65	80	100	100	
9	20	25	25	35	40	50	70	90	100	100	
6	30	35	40	45	55	75	95	100			
5	35	40	45	55	70	85	100	100	Circuit of Figure 1, except:		
4.5	35	45	50	60	75	95	100	100†	R_{CL} = 150 Ω		
3	55	65†	75†	95†	100†				C_F = 330 μF		
2.9	60†	70†	75†	100†	100†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

APPLICATION INFORMATION

Table 2. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 200 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										50	100
25									50	70	100
20						15	25	30	70	90	100
15				10	15	25	35	45	90	100	100
12	10	10	15	20	25	35	45	60	100	100	100
10	15	20	20	25	30	40	55	70	100	100	
9	20	20	25	30	35	45	60	80	100		
6	25	30	35	45	50	65	90	100			
5	30	35	40	55	60	75	100	100	Circuit of Figure 1, except:		
4.5	35	40	45	55	65	85	100	100†	R_{CL} = 200 Ω		
3	50	55†	65†	80†	90†				C_F = 330 μF		
2.9	50†	60†	65†	85†	100†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

Table 3. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 300 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										40	70
25									40	55	100
20						10	15	20	55	70	100
15				10	10	20	30	35	75	95	100
12	10	10	10	15	20	25	35	45	95	100	100
10	15	15	15	20	25	30	45	55	100	100	
9	15	15	20	25	30	35	50	60	100	100	
6	25	25	30	35	45	55	70	90			
5	30	30	35	45	50	65	85	100	Circuit of Figure 1, except:		
4.5	30	35	40	45	55	70	95	100†	R_{CL} = 300 Ω		
3	45	50†	55†	70†	90†				C_F = 330 μF		
2.9	45†	50†	60†	75†	95†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

APPLICATION INFORMATION

Table 4. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 510 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										30	50
25									25	40	75
20									40	55	90
15							15	20	55	70	100
12					10	15	25	35	65	80	100
10				10	20	25	30	40	70	85	
9	10	10	10	15	20	25	35	45	75	100	
6	15	20	20	25	30	35	50	60			
5	20	20	25	30	35	45	55	70	Circuit of Figure 1, except:		
4.5	20	25	30	35	40	50	65	90†	R_{CL} = 510 Ω		
3	35	35†	40†	50†	75†				C_F = 330 μF		
2.9	35†	35†	40†	55†	80†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

Table 5. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 1 kΩ

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30											35
25										35	50
20										35	60
15								10	30	45	65
12								20	40	45	85
10							15	25	40	55	
9				10	10	15	25	30	45	60	
6	10	10	10	15	20	20	30	35			
5	10	10	15	20	20	25	35	40	Circuit of Figure 1, except:		
4.5	15	15	15	20	25	30	40	45†	R_{CL} = 1 kΩ		
3	20	25†	25†	30†	35†				C_F = 330 μF		
2.9	20†	25†	25†	30†	45†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TL499ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL499ACPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
TL499ACPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL499ACPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

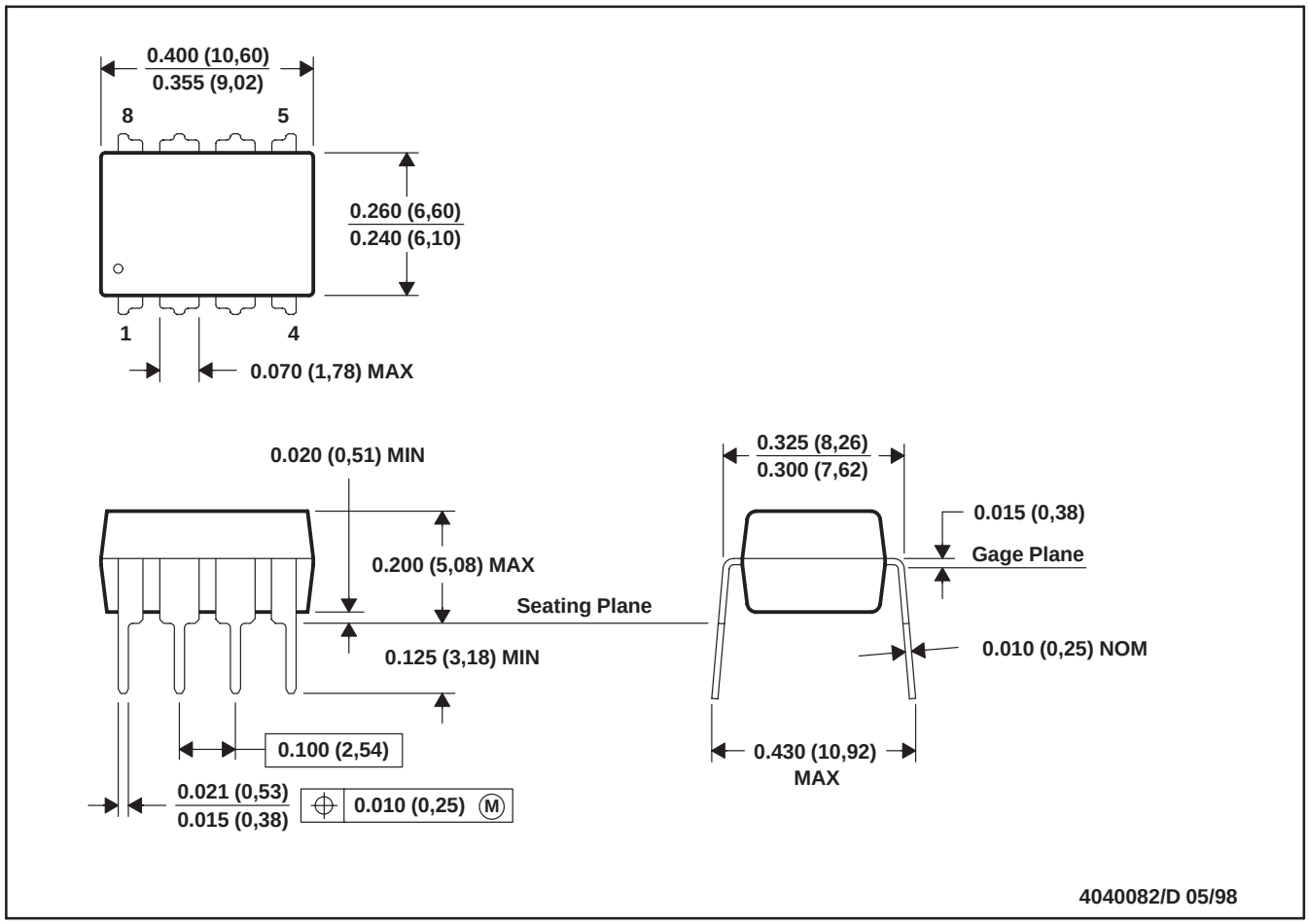
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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), Pb-Free (RoHS Exempt), 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.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
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.

MPDI001A – JANUARY 1995 – REVISED JUNE 1999

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

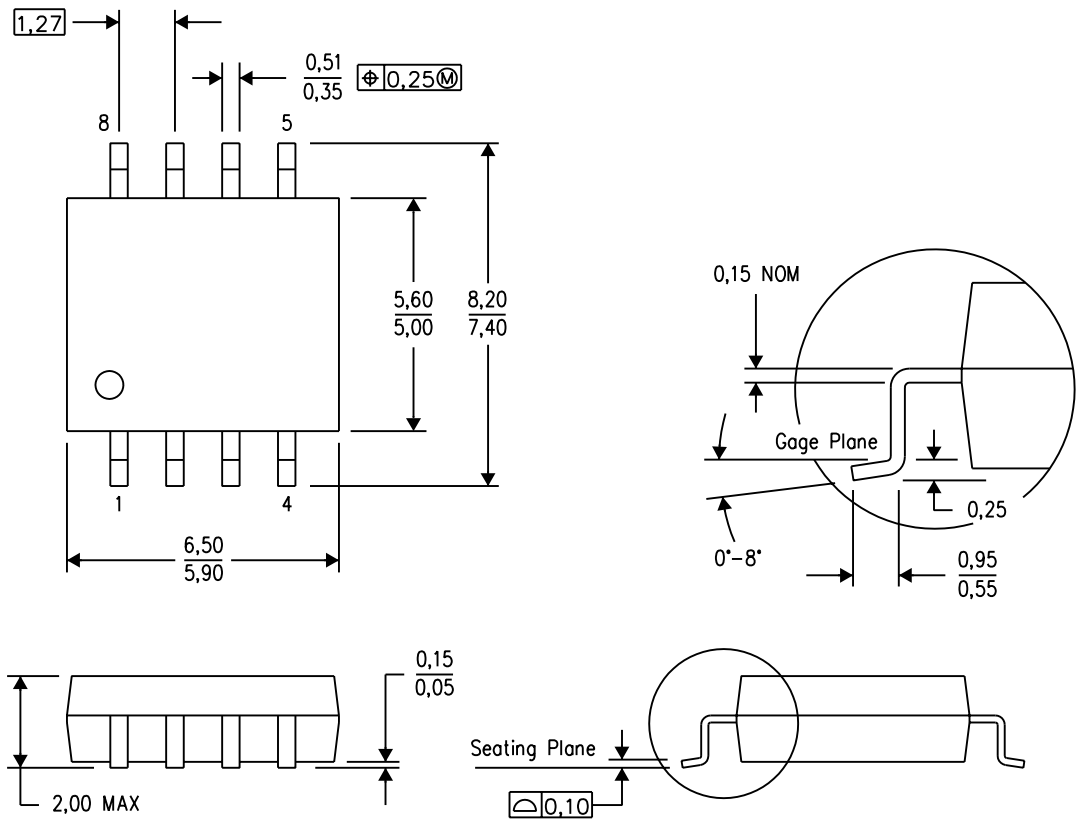


NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

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

MECHANICAL DATA

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



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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.

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