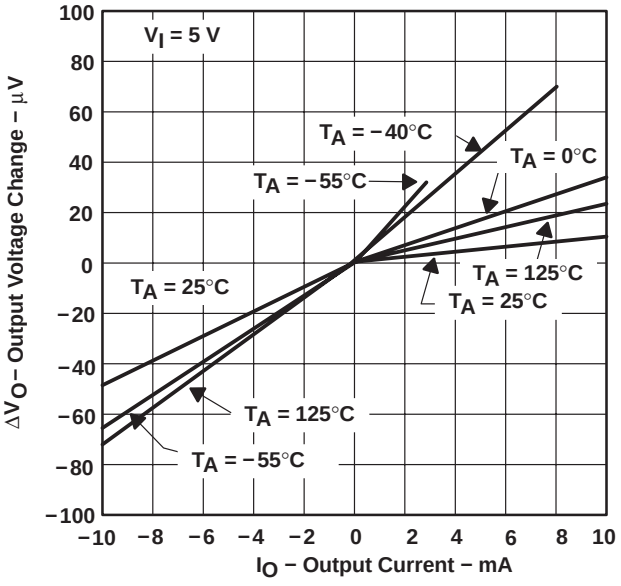
- **2.5-V Virtual Ground for 5-V/GND Analog Systems**
- **High Output-Current Capability Sink or Source . . . 20 mA Typ**
- **Micropower Operation . . . 170 μA Typ**
- **Excellent Regulation Characteristics**
  - **Output Regulation**
    - **−45 μV Typ at I_O = 0 to −10 mA**
    - **+15 μV Typ at I_O = 0 to +10 mA**
  - **Input Regulation = 1.5 μV/V Typ**
- **Low-Impedance Output . . . 0.0075 Ω Typ**
- **Macromodel Included**

description

In signal-conditioning applications using a single power source, a reference voltage is required for termination of all signal grounds. To accomplish this, engineers have typically used solutions consisting of resistors, capacitors, operational amplifiers, and voltage references. Texas Instruments has eliminated all of those components with one easy-to-use 3-terminal device. That device is the TLE2425 precision virtual ground.

Use of the TLE2425 over other typical circuit solutions gives the designer increased dynamic signal range, improved signal-to-noise ratio, lower distortion, improved signal accuracy, and easier interfacing to ADCs and DACs. These benefits are the result of combining a precision micropower voltage reference and a high-performance precision operational amplifier in a single silicon chip. It is the precision and performance of these two circuit functions together that yield such dramatic system-level performance.

OUTPUT REGULATION



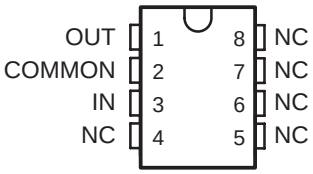
The TLE2425 improves input regulation as well as output regulation and, in addition, reduces output impedance and power dissipation in a majority of virtual-ground-generation circuits. Both input regulation and load regulation exceed 12 bits of accuracy on a single 5-V system. Signal-conditioning front ends of data acquisition systems that push 12 bits and beyond can use the TLE2425 to eliminate a major source of system error.

AVAILABLE OPTIONS

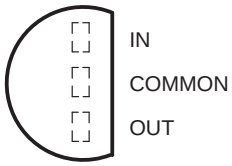
T_A	SMALL OUTLINE (D)	PLASTIC TO-226AA (LP)
0°C to 70°C	TLE2425CD	TLE2425CD
−40°C to 85°C	TLE2425ID	TLE2425ID
−55°C to 125°C	TLE2425MD	—

† The D package is available taped and reeled. Add R suffix to the device type (e.g., TLE2425CDR).

D, OR JG PACKAGE
(TOP VIEW)



LP PACKAGE
(TOP VIEW)



NC − No internal connection

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

Continuous input voltage, V_I . . . . . 40 V
Output current, I_O . . . . . ±80 mA
Duration of short-circuit current at (or below) 25°C (see Note 1) . . . . . unlimited
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 85°C
M-suffix . . . . . −55°C to 125°C
Storage temperature range, T_{stg} . . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or LP package . . . . . 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 output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

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	$T_A = 125°C$ POWER RATING
D	725 mV	5.8 mW/°C	464 mW	377 mW	145 mW
JG	1050 mV	8.4 mW/°C	672 mW	546 mW	210 mW
LP	775 mV	6.2 mW/°C	496 mW	403 mW	155 mW

recommended operating conditions

	C-SUFFIX		I-SUFFIX		M-SUFFIX		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
Input voltage, V_I	4	40	4	40	4	40	V
Operating free-air temperature, T_A	0	70	−40	85	−55	125	°C

electrical characteristics at specified free-air temperature, V_I = 5 V, I_O = 0 (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A†	TLE2425C			UNIT
				MIN	TYP	MAX	
Output voltage			25°C	2.48	2.5	2.52	V
			Full range	2.47		2.53	
Temperature coefficient of output voltage			25°C		20		ppm/°C
Bias current	I_O = 0		25°C		170	250	µA
			Full range			250	
Input voltage regulation	V_I = 4.5 V to 5.5 V		25°C		1.5	20	µV
			Full range			25	
	V_I = 4 V to 40 V		25°C		1.5	20	µV/V
			Full range			25	
Ripple rejection	f = 120 Hz,	$\Delta V_{I(PP)}$ = 1 V	25°C		80		dB
Output voltage regulation (source current)‡	I_O = 0 to −10 mA		25°C	−160	−45	160	µV
			Full range	−250		250	
	I_O = 0 to −20 mA		25°C	−450	−150	450	
Output voltage regulation (sink current)‡	I_O = 0 to 10 mA		25°C	−160	15	160	µV
			Full range	−250		250	
	I_O = 0 to 20 mA		25°C	−235	65	235	
Long-term drift of output voltage	Δt = 1000 h,	Noncumulative	25°C		15		ppm
Output impedance			25°C		7.5	22.5	mΩ
Short-circuit output current (sink current)	V_O = 5 V		25°C	30	55		mA
Short-circuit output current (source current)	V_O = 0			−30	−50		
Output noise voltage, rms	f = 10 Hz to 10 kHz		25°C		100		µV
Output voltage response to output current step	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		110		µs
		C_L = 100 pF			115		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0			180		
		C_L = 100 pF			180		
Output voltage response to input voltage step	V_I = 4.5 to 5.5 V,	V_O to 0.1%	25°C		12		µs
	V_I = 4.5 to 5.5 V,	V_O to 0.01%			30		
Output voltage turn-on response	V_I = 0 to 5 V,	V_O to 0.1%	25°C		125		µs
	V_I = 0 to 5 V,	V_O to 0.01%			210		

† Full range is 0°C to 70°C.
‡ The listed values are not production tested.

electrical characteristics at specified free-air temperature, V_I = 5 V, I_O = 0 (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A†	TLE2425I			UNIT
				MIN	TYP	MAX	
Output voltage			25°C	2.48	2.5	2.52	V
			Full range	2.47		2.53	
Temperature coefficient of output voltage			25°C		20		ppm/°C
Bias current	I_O = 0		25°C		170	250	µA
			Full range			250	
Input voltage regulation	V_I = 4.5 V to 5.5 V		25°C		1.5	20	µV
			Full range			75	
	V_I = 4 V to 40 V		25°C		1.5	20	µV/V
			Full range			75	
Ripple rejection	f = 120 Hz,	$\Delta V_{I(PP)}$ = 1 V	25°C		80		dB
Output voltage regulation (source current)‡	I_O = 0 to −10 mA		25°C	−160	−45	160	µV
			Full range	−250		250	
	I_O = 0 to −20 mA		25°C	−450	−150	450	
Output voltage regulation (sink current)‡	I_O = 0 to 8 mA		25°C	−160	15	160	µV
			Full range	−250		250	
	I_O = 0 to 20 mA		25°C	−235	65	235	
Long-term drift of output voltage	Δt = 1000 h,	Noncumulative	25°C		15		ppm
Output impedance			25°C		7.5	22.5	mΩ
Short-circuit output current (sink current)	V_O = 5 V		25°C	30	55		mA
Short-circuit output current (source current)	V_O = 0			−30	−50		
Output noise voltage, rms	f = 10 Hz to 10 kHz		25°C		100		µV
Output voltage response to output current step	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		110		µs
		C_L = 100 pF			115		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0			180		
		C_L = 100 pF			180		
Output voltage response to input voltage step	V_I = 4.5 to 5.5 V,	V_O to 0.1%	25°C		12		µs
	V_I = 4.5 to 5.5 V,	V_O to 0.01%			30		
Output voltage turn-on response	V_I = 0 to 5 V,	V_O to 0.1%	25°C		125		µs
	V_I = 0 to 5 V,	V_O to 0.01%			210		

† Full range is −40°C to 85°C.
‡ The listed values are not production tested.

electrical characteristics at specified free-air temperature, V_I = 5 V, I_O = 0 (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A†	TLE2425M			UNIT
				MIN	TYP	MAX	
Output voltage			25°C	2.48	2.5	2.52	V
			Full range	2.47		2.53	
Temperature coefficient of output voltage			25°C		20		ppm/°C
Bias current	I_O = 0		25°C		170	250	µA
			Full range			250	
Input voltage regulation	V_I = 4.5 V to 5.5 V		25°C		1.5	20	µV
			Full range			100	
	V_I = 4.5 V to 40 V		25°C		1.5	20	µV/V
			Full range			100	
Ripple rejection	f = 120 Hz,	$\Delta V_{I(PP)}$ = 1 V	25°C		80		dB
Output voltage regulation (source current)‡	I_O = 0 to −10 mA		25°C	−160	−45	160	µV
			Full range	−250		250	
	I_O = 0 to −20 mA		25°C	−450	−150	450	
Output voltage regulation (sink current)‡	I_O = 0 to 3 mA		25°C	−160	15	160	µV
			Full range	−250		250	
	I_O = 0 to 20 mA		25°C	−235	65	235	
Long-term drift of output voltage	Δt = 1000 h,	Noncumulative	25°C		15		ppm
Output impedance			25°C		7.5	22.5	mΩ
Short-circuit output current (sink current)	V_O = 5 V		25°C	30	55		mA
Short-circuit output current (source current)	V_O = 0			−30	−50		
Output noise voltage, rms	f = 10 Hz to 10 kHz		25°C		100		µV
Output voltage response to output current step	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		110		µs
		C_L = 100 pF			115		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0			180		
		C_L = 100 pF			180		
Output voltage response to input voltage step	V_I = 4.5 to 5.5 V,	V_O to 0.1%	25°C		12		µs
	V_I = 4.5 to 5.5 V,	V_O to 0.01%			30		
Output voltage turn-on response	V_I = 0 to 5 V,	V_O to 0.1%	25°C		125		µs
	V_I = 0 to 5 V,	V_O to 0.01%			210		

† Full range is −55°C to 125°C.
‡ The listed values are not production tested.

TYPICAL CHARACTERISTICS

Table Of Graphs

		FIGURE
Output voltage	Distribution	1
	vs Free-air temperature	2
Output voltage hysteresis	vs Free-air temperature	3
Input bias current	vs Input voltage	4
	vs Free-air temperature	5
Input voltage regulation		6
Ripple rejection	vs Frequency	7
Output voltage regulation		8
Output impedance	vs Frequency	9
Short-circuit output current	vs Free-air temperature	10
Spectral noise voltage density	vs Frequency	11
Wide-band noise voltage	vs Frequency	12
Output voltage change with current step	vs Time	13
Output voltage change with voltage step	vs Time	14
Output voltage power-up response	vs Time	15
Output current	vs Load capacitance	16

TYPICAL CHARACTERISTICS†

DISTRIBUTION OF OUTPUT VOLTAGE

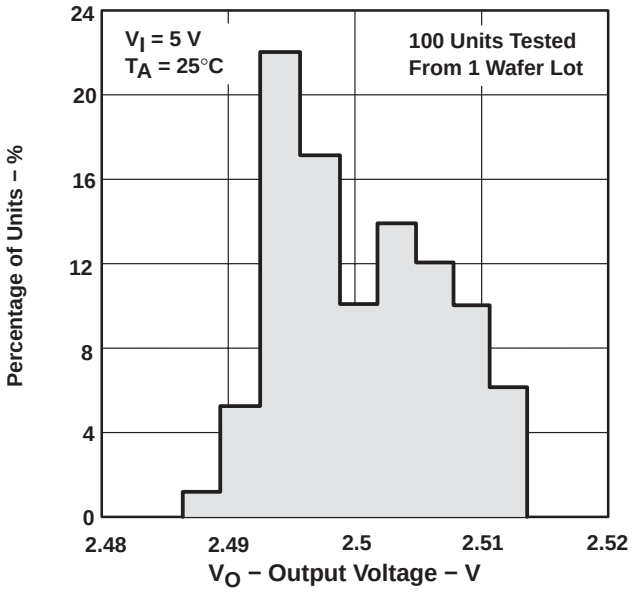


Figure 1

OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE

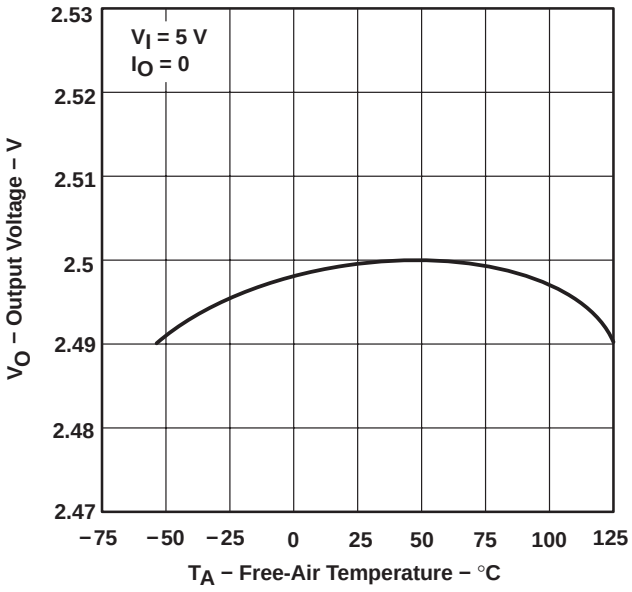


Figure 2

OUTPUT VOLTAGE HYSTERESIS vs FREE-AIR TEMPERATURE

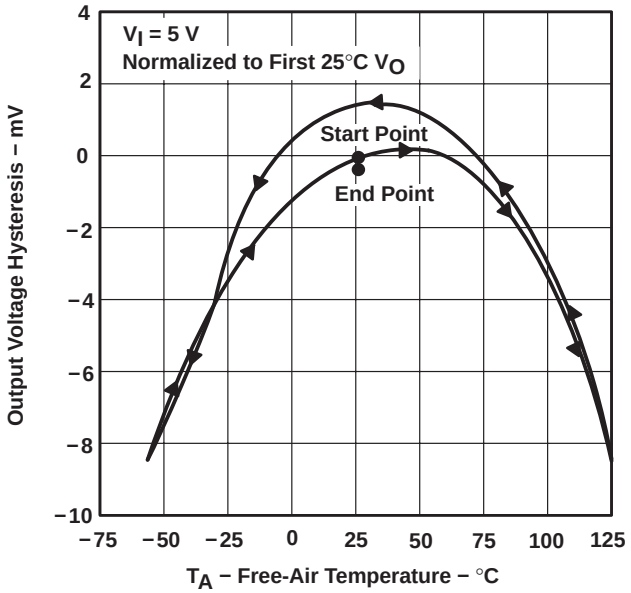


Figure 3

INPUT BIAS CURRENT vs INPUT VOLTAGE

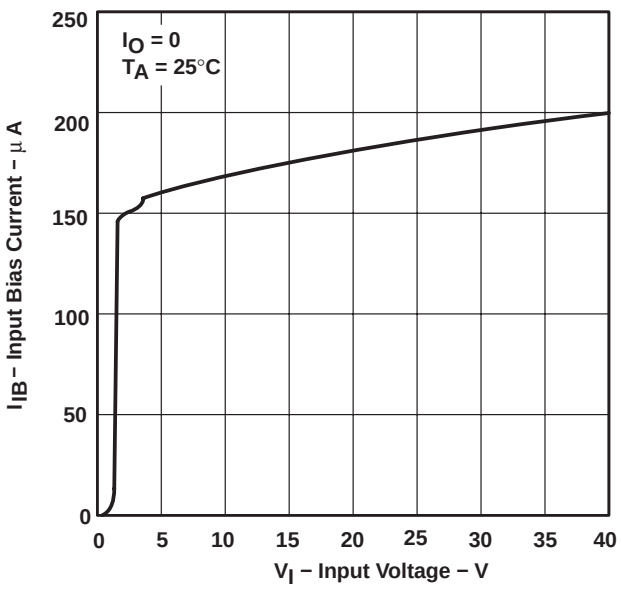


Figure 4

† Data at high and low temperatures are applicable within rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

INPUT BIAS CURRENT vs FREE-AIR TEMPERATURE

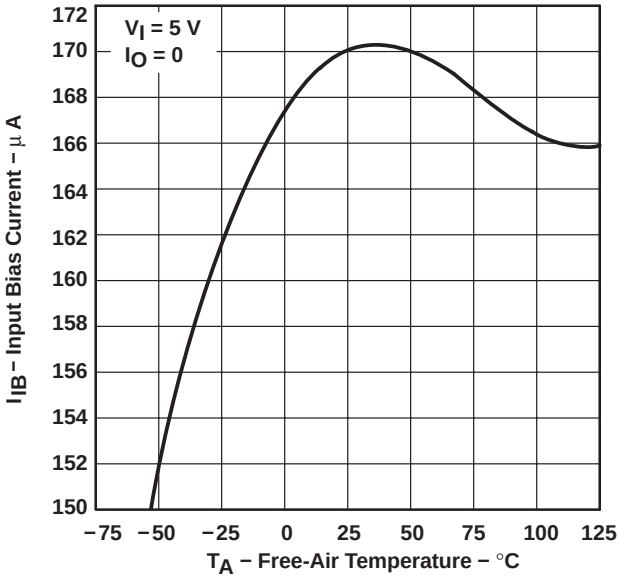


Figure 5

INPUT VOLTAGE REGULATION

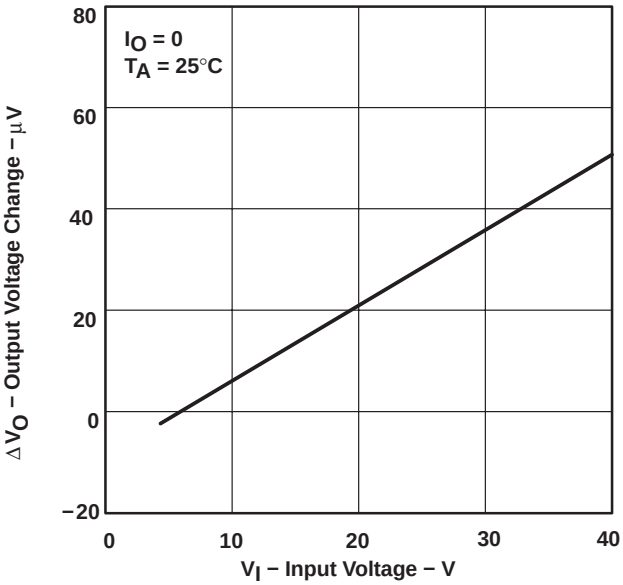


Figure 6

RIPPLE REJECTION vs FREQUENCY

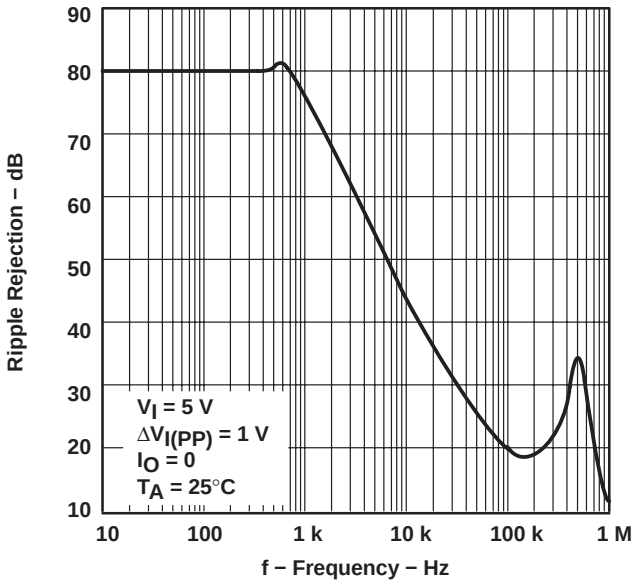


Figure 7

OUTPUT VOLTAGE REGULATION

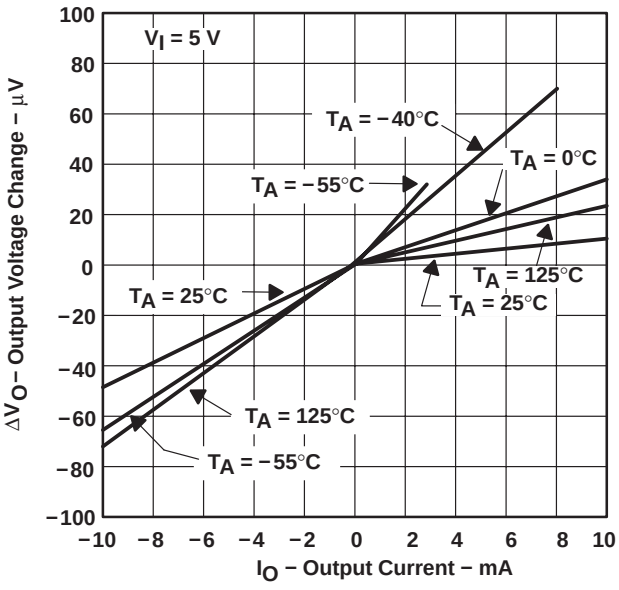


Figure 8

† Data at high and low temperatures are applicable within rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS

OUTPUT IMPEDANCE vs FREQUENCY

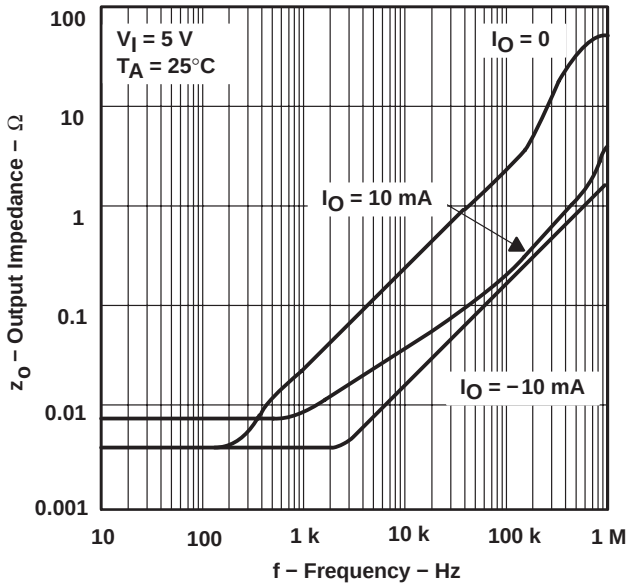


Figure 9

SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE

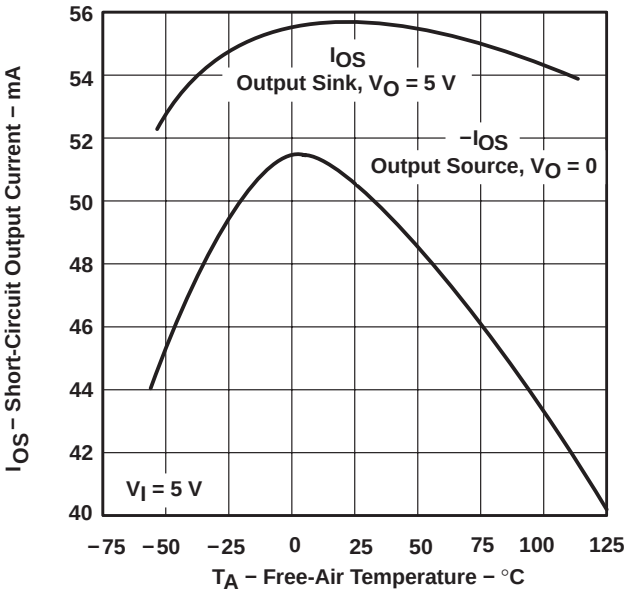


Figure 10

SPECTRAL NOISE VOLTAGE DENSITY vs FREQUENCY

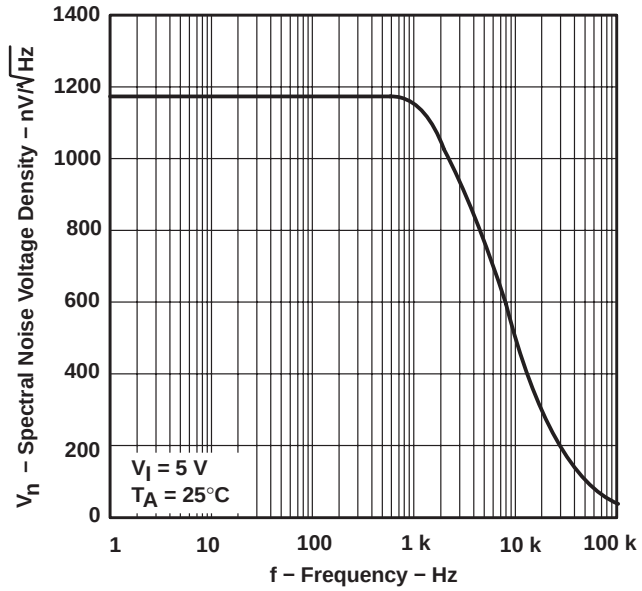


Figure 11

WIDE-BAND NOISE VOLTAGE vs FREQUENCY

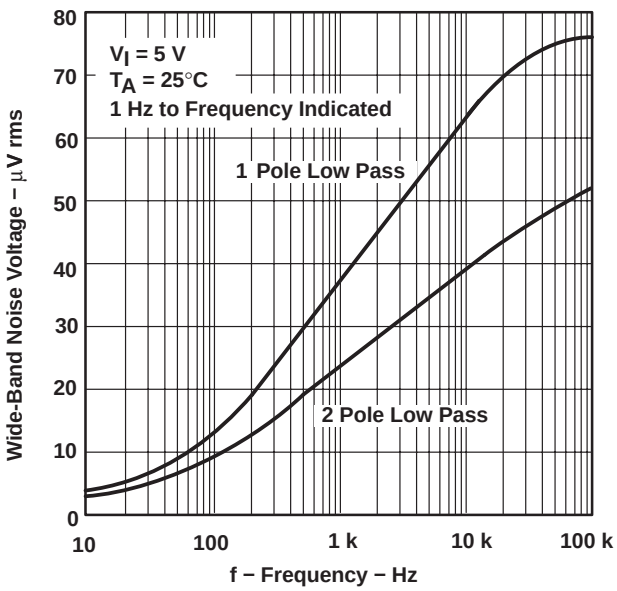


Figure 12

TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE RESPONSE TO OUTPUT CURRENT STEP vs TIME

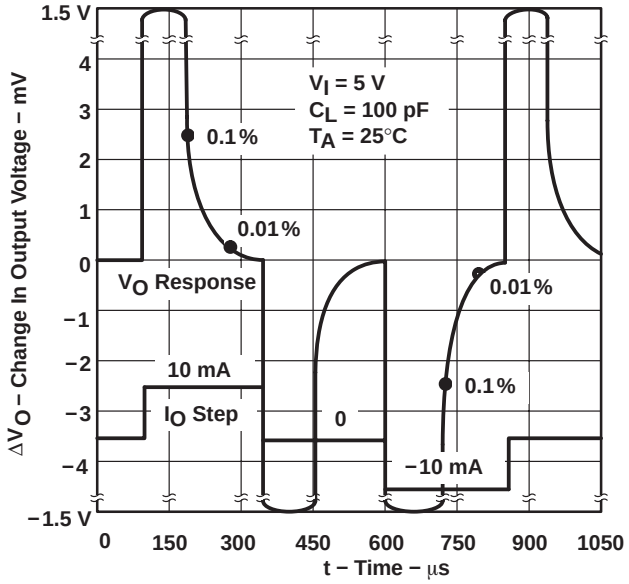


Figure 13

OUTPUT VOLTAGE RESPONSE TO INPUT VOLTAGE STEP vs TIME

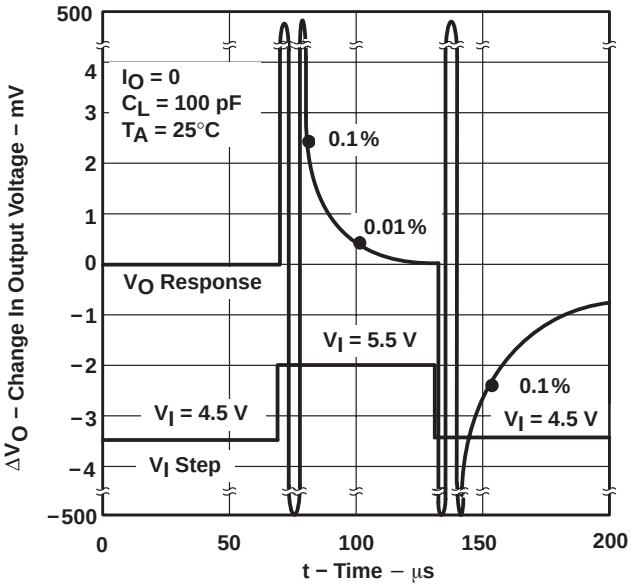


Figure 14

OUTPUT VOLTAGE POWER-UP RESPONSE vs TIME

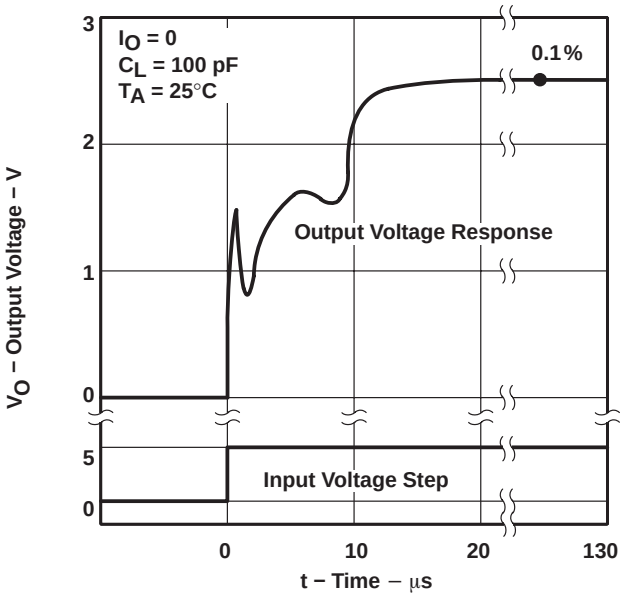


Figure 15

STABILITY RANGE OUTPUT CURRENT vs LOAD CAPACITANCE

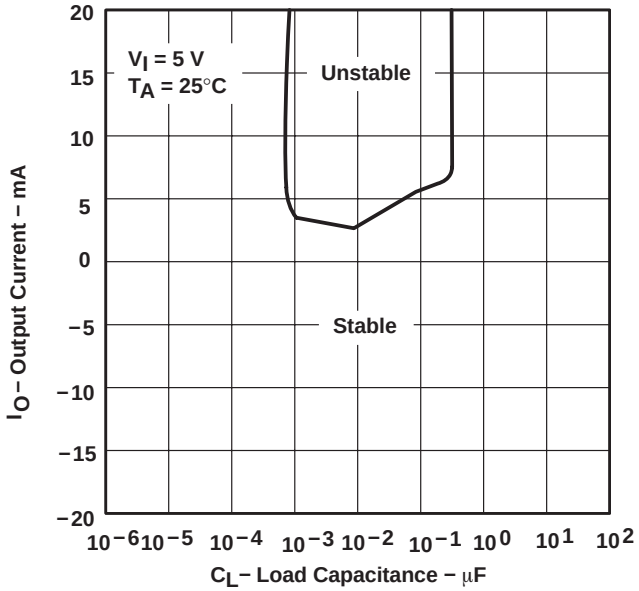


Figure 16

macromodel information

```
*   TLE2425 OPERATIONAL AMPLIFIER "MACROMODEL" SUBCIRCUIT
*   CREATED USING PARTS RELEASE 4.03 ON 08/21/90 AT 13:51
*   REV (N/A)     SUPPLY VOLTAGE: 5 V
*   CONNECTIONS:  INPUT
*                 |   COMMON
*                 |   |   OUTPUT
*                 |   |   |
.SUBCKT TLE2425   3   4   5
*
```

```
*   OPAMP SECTION
    C1     11  12  21.66E-12
    C2      6  7   30.00E-12
    C3     87  0   10.64E-9
    CPSR   85  86  15.9E-9
    DCM+   81  82  DX
    DCM-   83  81  DX
    DC      5  53  DX
    DE     54  5   DX
    DLN    92  90  DX
    DLP    90  91  DX
    DP      4  3   DX
    ECMR   84  99  (2,99) 1
    EGND   99  0   POLY(2)   (3,0)  (4,0)  0   .5 .5
    EPSR   85  0   POLY(1)   (3,4)  -16.22E-6 3.24E-6
    ENSE   89  2   POLY(1)   (88,0) 120E-6 1
    FB      7  99  POLY(6)   VB  VC  VE  VLP VLN VPSR   0   74.8E6 -10E6  10E6   10E6
+   -10E6  74E6
    GA      6  0   11  12  320.4E-6
    GCM     0  6   10  99  1.013E-9
    GPSR   85  86  (85,86)   100E-6
    GRC1   4   11  (4,11) 3.204E-4
    GRC2   4   12  (4,12) 3.204E-4
    GRE1   13  10  (13,10)   1.038E-3
    GRE2   14  10  (14,10)   1.038E-3
    HLIM   90  0   VLIM   1K
    HCMR   80  1   POLY(2)   VCM+   VCM-   0   1E2 1E2
    IRP     3  4   146E-6
    IEE     3  10  DC  24.05E-6
    IIO     2  0   .2E-9
    I1     88  0   1E-21
    Q1     11  89  13  QX
    Q2     12  80  14  QX
    R2      6  9   100.0E3
    RCM    84  81  1K
    REE    10  99  8.316E6
    RN1    87  0   2.55E8
    RN2    87  88  11.67E3
```

macromodel information (continued)

```
        RO1     8  5   63
        RO2     7  99  62
        VCM+   82  99  1.0
        VCM-   83  99  -2.3
        VB      9  0   DC  0
        VC      3  53  DC  1.400
        VE     54  4   DC  1.400
        VLIM    7  8   DC  0
        VLP    91  0   DC  30
        VLN     0  92  DC  30
        VPSR    0  86  DC  0
        RFB     5  2   1K
        RIN    30  1   1K
        RCOM   34  4   .1
    *REGULATOR SECTION
        RG1    30  0   20MEG
        RG2    30  31  .2
        RG3    31  35  400K
        RG4    35  34  411K
        RG5    31  36  25MEG
        HREG   31  32  POLY(2)   VPSET  VNSET  0   1E2 1E2
        VREG   32  33  DC  0V
        EREG   33  34  POLY(1)   (36,34)   1.23 1
        VADJ   36  34  1.27V
        HPSET  37  0   VREG   1.030E3
        VPSET  38  0   DC  20V
        HNSET  39  0   VREG   6.11E5
        VNSET  40  0   DC  -20V
        DSUB    4  34  DX
        DPOS   37  38  DX
        DNNEG  40  39  DX
    .MODEL DX  D(IS=800.0E-18)
    .MODEL QX  PNP(IS=800.0E-18 BF=480)
    .ENDS
```

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
5962-9555601Q2A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
5962-9555601QPA	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TLE2425CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CLP	ACTIVE	TO-92	LP	3	1000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TLE2425CLPE3	ACTIVE	TO-92	LP	3	1000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TLE2425CLPR	OBSOLETE	TO-92	LP	3		TBD	Call TI	Call TI
TLE2425CPS	ACTIVE	SO	PS	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CPSG4	ACTIVE	SO	PS	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425CPSRG4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2425ILP	ACTIVE	TO-92	LP	3	1000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TLE2425ILPE3	ACTIVE	TO-92	LP	3	1000	Pb-Free (RoHS)	CU SN	N / A for Pkg Type
TLE2425MD	ACTIVE	SOIC	D	8	75	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLE2425MDR	ACTIVE	SOIC	D	8	2500	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLE2425MFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
TLE2425MJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TLE2425MJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TLE2425MLP	OBSOLETE	TO-92	LP	3		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), 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)

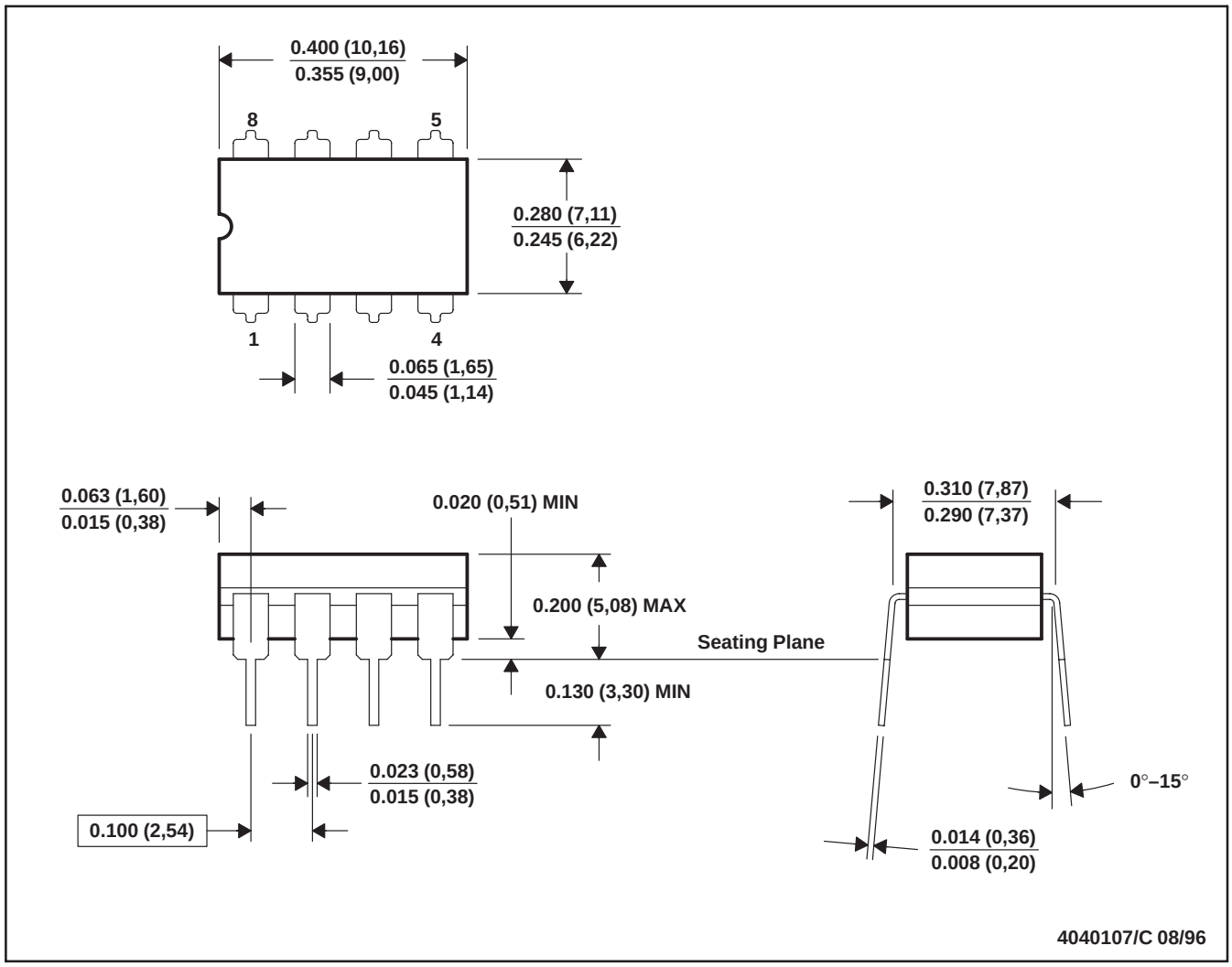
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

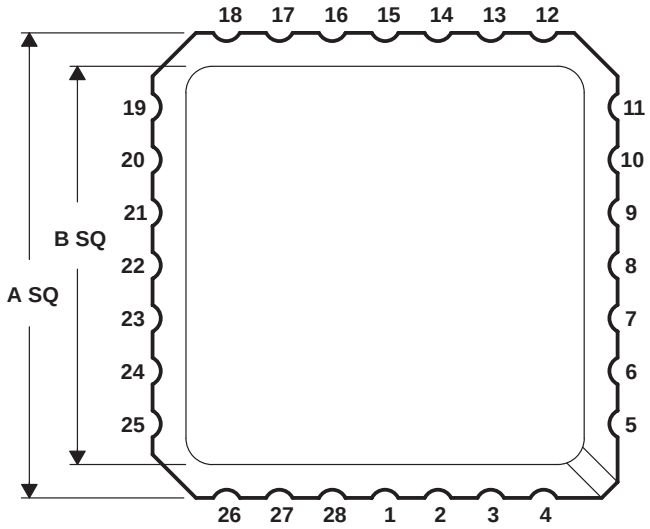
JG (R-GDIP-T8) **CERAMIC DUAL-IN-LINE**



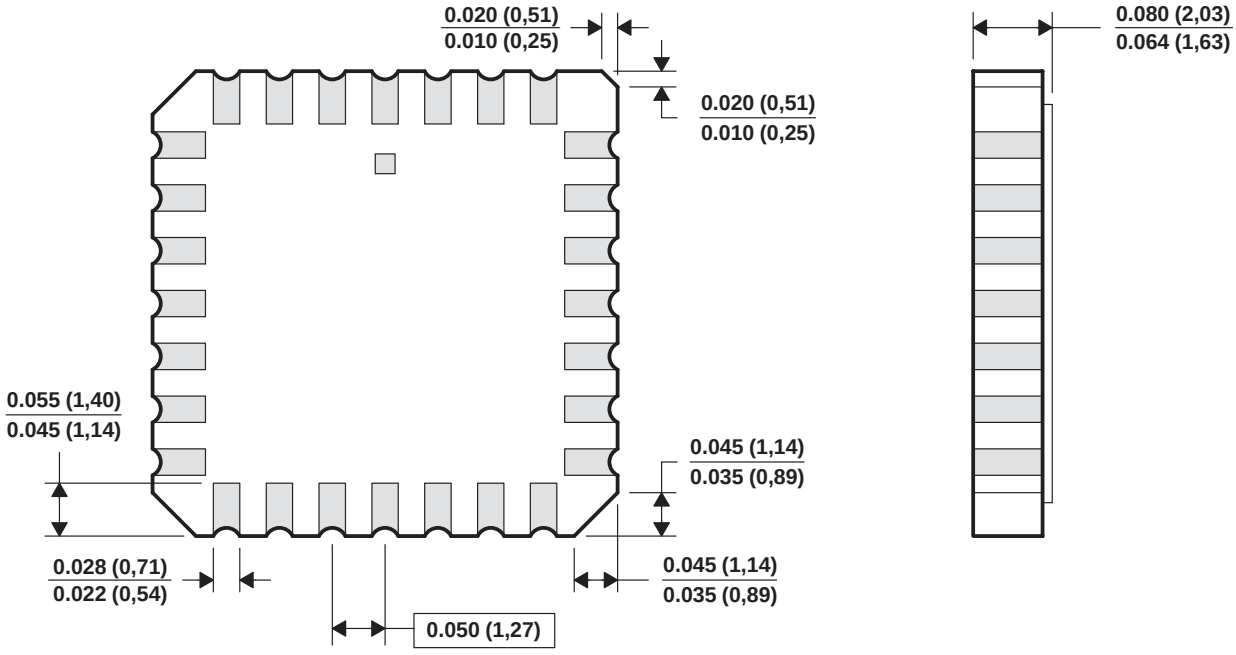
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP1-T8

FK (S-CQCC-N)** **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN



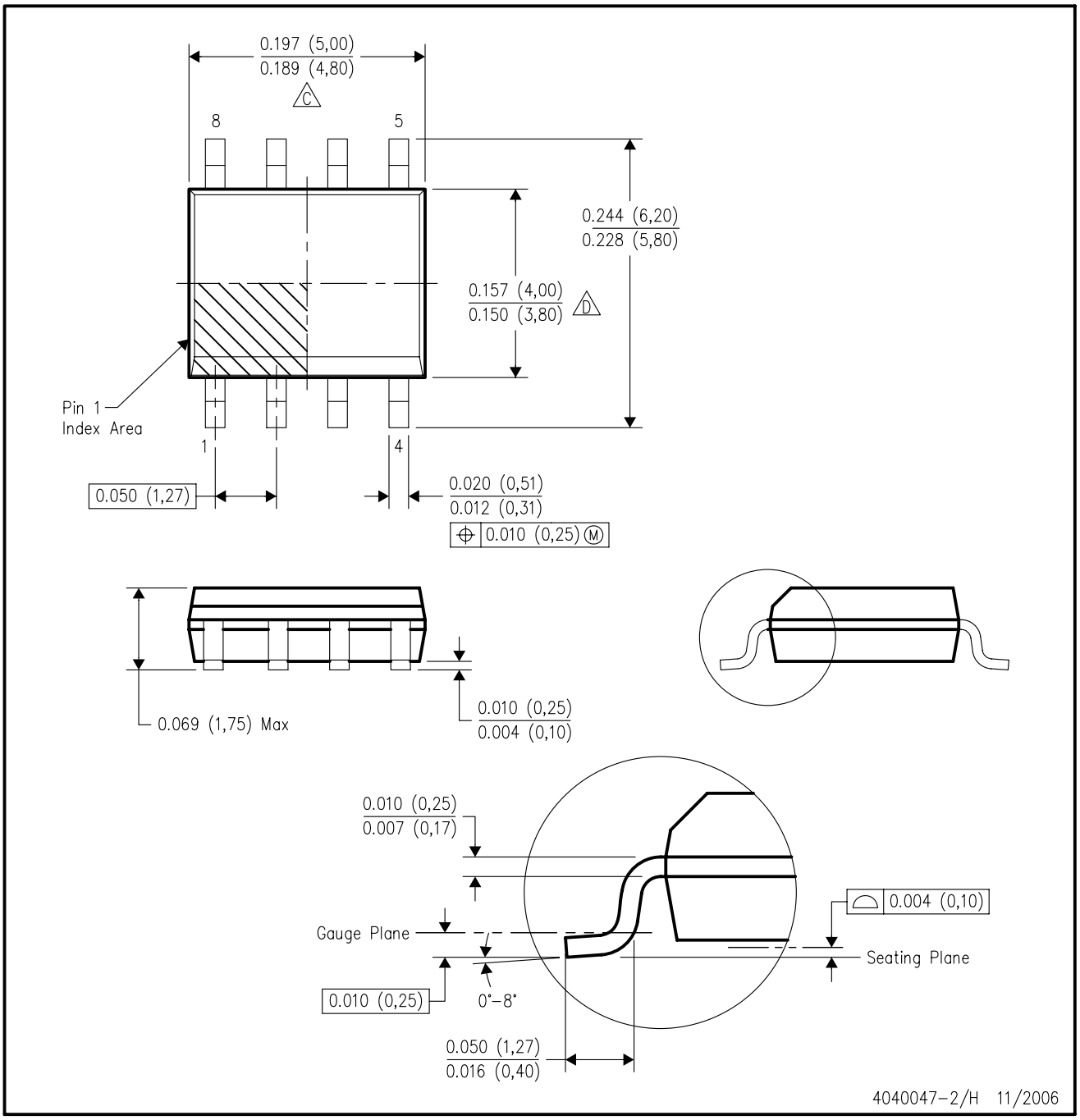
NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

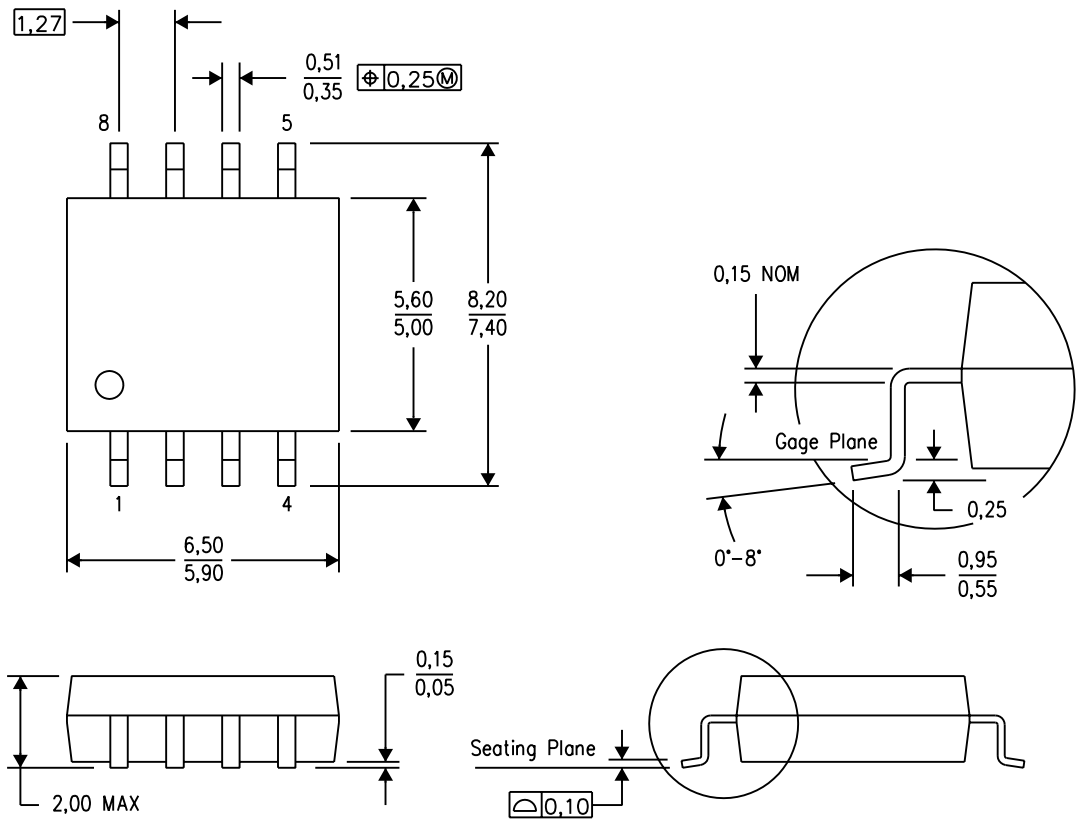
D (R–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE



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 .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AA.

MECHANICAL DATA

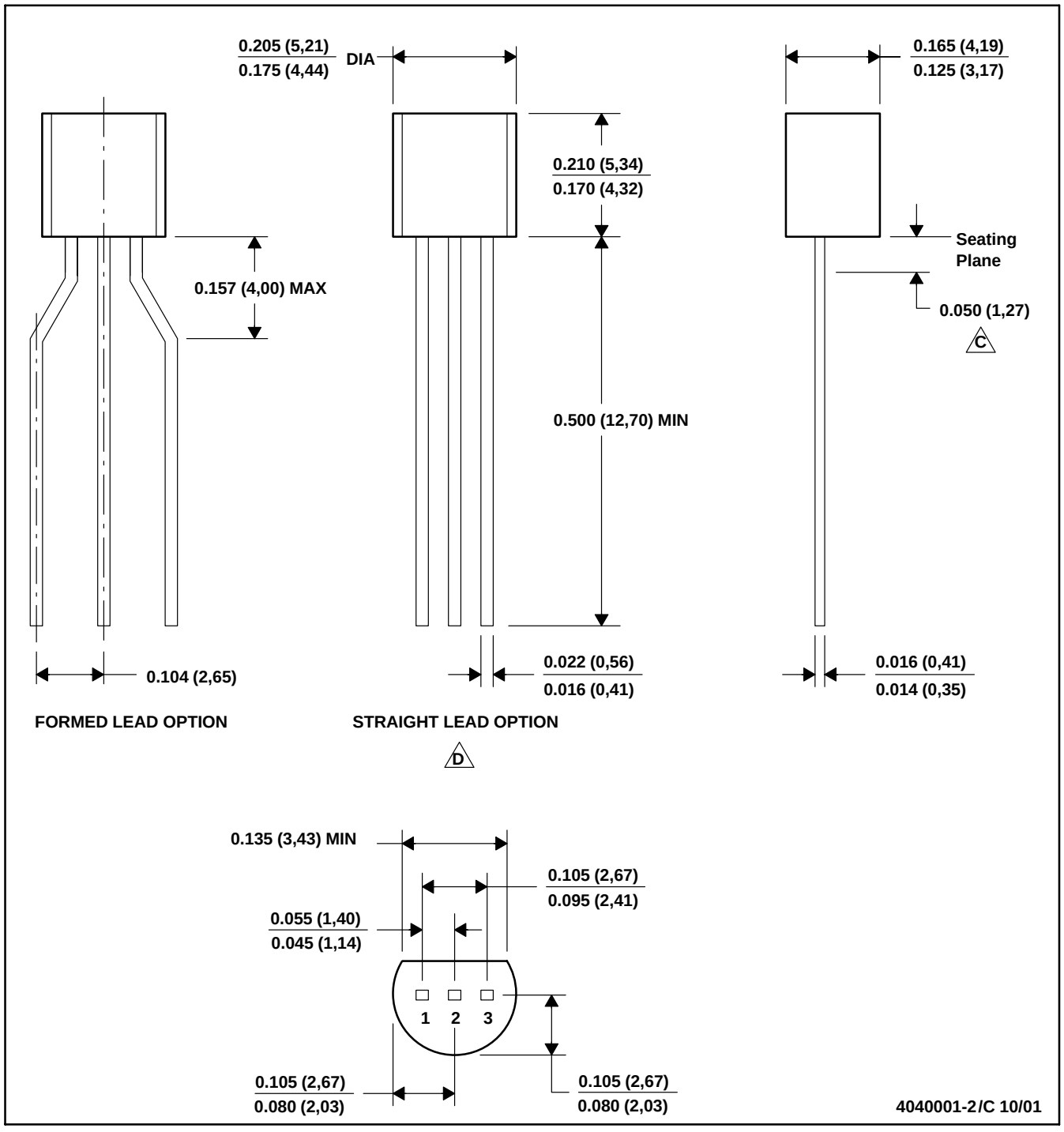
PS (R-PDSO-G8) **PLASTIC SMALL-OUTLINE PACKAGE**



4040063/C 03/03

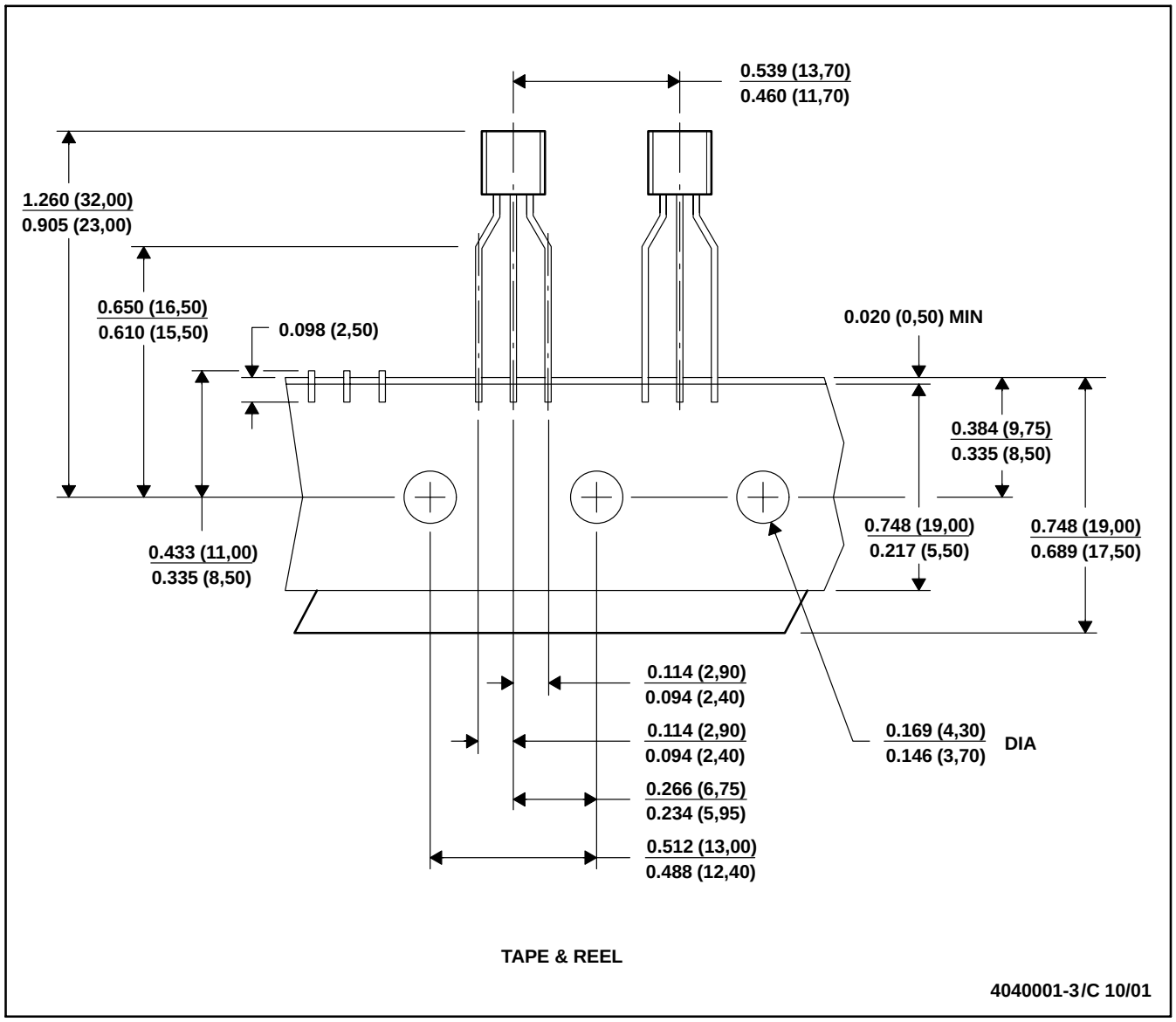
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

LP (O-PBCY-W3) **PLASTIC CYLINDRICAL PACKAGE**



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area
D. FAlls within JEDEC TO -226 Variation AA (TO-226 replaces TO-92)
E. Shipping Method:
Straight lead option available in bulk pack only.
Formed lead option available in tape & reel or ammo pack.

LP (O-PBCY-W3) **PLASTIC CYLINDRICAL PACKAGE**



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Tape and Reel information for the Format Lead Option package.

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 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.

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.

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

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
Low Power Wireless	www.ti.com/lpw	Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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