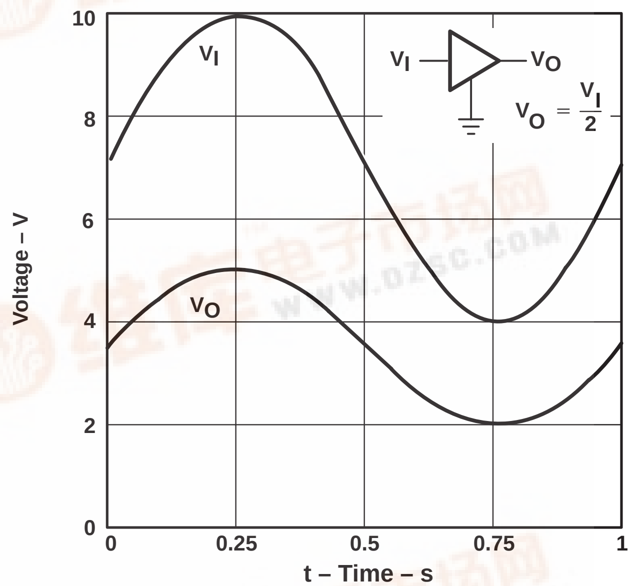
TLE2426, TLE2426Y THE “RAIL SPLITTER” PRECISION VIRTUAL GROUND

SLOS098D – AUGUST 1991 – REVISED MAY 1998

- **1/2 V_I Virtual Ground for Analog Systems**
- **Self-Contained 3-terminal TO-226AA Package**
- **Micropower Operation . . . 170 µA Typ, V_I = 5 V**
- **Wide V_I Range . . . 4 V to 40 V**
- **High Output-Current Capability**
  - **Source . . . 20 mA Typ**
  - **Sink . . . 20 mA Typ**
- **Excellent Output Regulation**
  - **−45 µV Typ at I_O = 0 to −10 mA**
  - **+15 µV Typ at I_O = 0 to +10 mA**
- **Low-Impedance Output . . . 0.0075 Ω Typ**
- **Noise Reduction Pin (D, JG, and P Packages Only)**

INPUT/OUTPUT TRANSFER CHARACTERISTICS



description

In signal-conditioning applications utilizing a single power source, a reference voltage equal to one-half the supply voltage is required for termination of all analog signal grounds. Texas Instruments presents a precision virtual ground whose output voltage is always equal to one-half the input voltage, the TLE2426 “rail splitter.”

The unique combination of a high-performance, micropower operational amplifier and a precision-trimmed divider on a single silicon chip results in a precise V_O/V_I ratio of 0.5 while sinking and sourcing current. The TLE2426 provides a low-impedance output with 20 mA of sink and source capability while drawing less than 280 µA of supply current over the full input range of 4 V to 40 V. A designer need not pay the price in terms of board space for a conventional signal ground consisting of resistors, capacitors, operational amplifiers, and voltage references. The performance and precision of the TLE2426 is available in an easy-to-use, space saving, 3-terminal LP package. For increased performance, the optional 8-pin packages provide a noise-reduction pin. With the addition of an external capacitor (C_{NR}), peak-to-peak noise is reduced while line ripple rejection is improved.

Initial output tolerance for a single 5-V or 12-V system is better than 1% with 3.6% over the full 40-V input range. Ripple rejection exceeds 12 bits of accuracy. Whether the application is for a data acquisition front end, analog signal termination, or simply a precision voltage reference, the TLE2426 eliminates a major source of system error.

AVAILABLE OPTIONS

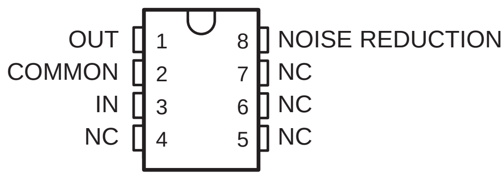
T_A	PACKAGED DEVICES SMALL OUTLINE (D)	PACKAGED DEVICES CERAMIC DIP (JG)	PACKAGED DEVICES PLASTIC (LP)	PACKAGED DEVICES PLASTIC DIP (P)	CHIP FORM (Y)
0°C to 70°C	TLE2426CD	—	TLE2426CLP	TLE2426CP	TLE2426Y
−40°C to 85°C	TLE2426ID	—	TLE2426ILP	TLE2426IP	
−55°C to 125°C	TLE2426MD	TLE2426MJG	TLE2426MLP	TLE2426MP	

The D and LP packages are available taped and reeled in the commercial temperature range only. Add R suffix to the device type (e. g., TLC2426CDR). Chips are tested at 25°C.

description (continued)

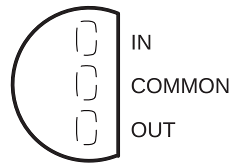
The C-suffix devices are characterized for operation from 0°C to 70°C. The I suffix devices are characterized for operation from –40°C to 85°C. The M suffix devices are characterized over the full military temperature range of –55°C to 125°C.

D, JG, OR P PACKAGE
(TOP VIEW)



NC – No internal connection

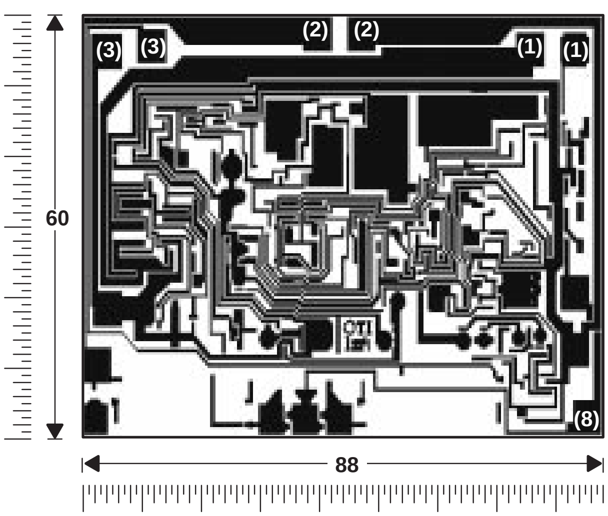
LP PACKAGE
(TOP VIEW)

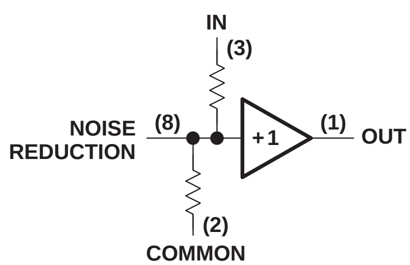


TLE2426Y chip information

This chip, properly assembled, displays characteristics similar to the TLE2426C. Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chips may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS:
15 MILS TYPICAL

BONDING PADS:
4 × 4 MILS MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

NOTE A: Both bonding pads numbered 1, both numbered 2, and both numbered 3, must be bonded out to the corresponding functions pin.

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

Continuous input voltage, V_I		40 V
Continuous filter trap voltage		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 or P 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
P	1000 mV	8.0 mW/°C	640 mW	520 mW	200 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†	TLE2426C MIN	TLE2426C TYP	TLE2426C MAX	UNIT
Output voltage	V_I = 4 V		25°C	1.98	2	2.02	V
	V_I = 5 V		25°C	2.48	2.5	2.52	V
	V_I = 40 V		25°C	19.8	20	20.2	V
	V_I = 5 V		Full range	2.475		2.525	V
Temperature coefficient of output voltage			Full range		25		ppm/°C
Supply current	No load	V_I = 5 V	25°C		170	300	µA
	No load	V_I = 4 to 40 V	Full range			400	µA
Output voltage regulation (sourcing current)‡	I_O = 0 to –10 mA		25°C		–45	±160	µV
	I_O = 0 to –10 mA		Full range			±250	µV
	I_O = 0 to –20 mA		25°C		–150	±450	µV
Output voltage regulation (sinking current)‡	I_O = 0 to 10 mA		25°C		15	±160	µV
	I_O = 0 to 10 mA		Full range			±250	µV
	I_O = 0 to 20 mA		25°C		65	±235	µV
Output impedance			25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	V_O = 5 V	25°C		26		mA
	Sourcing current,	V_O = 0	25°C		–47		mA
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0	25°C		120		µV
	f = 10 Hz to 10 kHz	C_{NR} = 1 µF	25°C		30		µV
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		290		µs
	V_O to 0.1%, I_O = ±10 mA	C_L = 100 pF	25°C		275		µs
	V_O to 0.01%, I_O = ±10 mA	C_L = 0	25°C		400		µs
	V_O to 0.01%, I_O = ±10 mA	C_L = 100 pF	25°C		390		µs
Step response	V_I = 0 to 5 V, V_O to 0.1%	C_L = 100 pF	25°C		20		µs
	V_I = 0 to 5 V, V_O to 0.01%	C_L = 100 pF	25°C		160		µs

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

electrical characteristics at specified free-air temperature, V_I = 12 V, I_O = 0 (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A†	TLE2426C MIN	TLE2426C TYP	TLE2426C MAX	UNIT
Output voltage	V_I = 4 V		25°C	1.98	2	2.02	V
	V_I = 12 V			5.95	6	6.05	
	V_I = 40 V			19.8	20	20.2	
	V_I = 12 V		Full range	5.945		6.055	
Temperature coefficient of output voltage			Full range		35		ppm/°C
Supply current	No load	V_I = 12 V	25°C		195	300	µA
		V_I = 4 to 40 V	Full range			400	
Output voltage regulation (sourcing current)‡	I_O = 0 to –10 mA		25°C		–45	±160	µV
			Full range			±250	
	I_O = 0 to –20 mA		25°C		–150	±450	
Output voltage regulation (sinking current)‡	I_O = 0 to 10 mA		25°C		15	±160	µV
			Full range			±250	
	I_O = 0 to 20 mA		25°C		65	±235	
Output impedance			25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	V_O = 12 V	25°C		31		mA
	Sourcing current,	V_O = 0			–70		
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0	25°C		120		µV
		C_{NR} = 1 µF			30		
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		290		µs
		C_L = 100 pF			275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0	25°C		400		
		C_L = 100 pF			390		
Step response	V_I = 0 to 12 V, V_O to 0.1%	C_L = 100 pF	25°C		20		µs
	V_I = 0 to 12 V, V_O to 0.01%				120		

† 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†	TLE2426I			UNIT
				MIN	TYP	MAX	
Output voltage	V_I = 4 V		25°C	1.98	2	2.02	V
	V_I = 5 V		25°C	2.48	2.5	2.52	
	V_I = 40 V		25°C	19.8	20	20.2	
	V_I = 5 V		Full range	2.47		2.53	
Temperature coefficient of output voltage			Full range		25		ppm/°C
Supply current	No load	V_I = 5 V	25°C		170	300	μA
		V_I = 4 to 40 V	Full range			400	
Output voltage regulation (sourcing current)‡	I_O = 0 to –10 mA		25°C		–45	±160	μV
			Full range			±250	
	I_O = 0 to –20 mA		25°C		–150	±450	
Output voltage regulation (sinking current)‡	I_O = 0 to 10 mA		25°C		15	±160	μV
	I_O = 0 to 8 mA		Full range			±250	
	I_O = 0 to 20 mA		25°C		65	±235	
Output impedance			25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	V_O = 5 V	25°C		26		mA
	Sourcing current,	V_O = 0			–47		
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0	25°C		120		μV
		C_{NR} = 1 μF			30		
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		290		μs
		C_L = 100 pF			275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0	25°C		400		
		C_L = 100 pF			390		
Step response	V_I = 0 to 5 V, V_O to 0.1%	C_L = 100 pF	25°C		20		μs
	V_I = 0 to 5 V, V_O to 0.01%				160		

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

electrical characteristics at specified free-air temperature, V_I = 12 V, I_O = 0 (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A†	TLE2426I MIN	TLE2426I TYP	TLE2426I MAX	UNIT
Output voltage	V_I = 4 V		25°C	1.98	2	2.02	V
	V_I = 12 V		25°C	5.95	6	6.05	
	V_I = 40 V		25°C	19.8	20	20.2	
	V_I = 12 V		Full range	5.935		6.065	
Temperature coefficient of output voltage			Full range		35		ppm/°C
Supply current	No load	V_I = 12 V	25°C		195	300	μA
		V_I = 4 to 40 V	Full range			400	
Output voltage regulation (sourcing current)‡	I_O = 0 to –10 mA		25°C		–45	±160	μV
			Full range			±250	
	I_O = 0 to –20 mA		25°C		–150	±450	
Output voltage regulation (sinking current)‡	I_O = 0 to 10 mA		25°C		15	±160	μV
	I_O = 0 to 8 mA		Full range			±250	
	I_O = 0 to 20 mA		25°C		65	±235	
Output impedance			25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	V_O = 12 V	25°C		31		mA
	Sourcing current,	V_O = 0			–70		
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0	25°C		120		μV
		C_{NR} = 1 μF			30		
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		290		μs
		C_L = 100 pF			275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0	25°C		400		
		C_L = 100 pF			390		
Step response	V_I = 0 to 12 V, V_O to 0.1%	C_L = 100 pF	25°C		20		μs
	V_I = 0 to 12 V, V_O to 0.01%				120		

† 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†	TLE2426M MIN	TLE2426M TYP	TLE2426M MAX	UNIT
Output voltage	V_I = 4 V		25°C	1.98	2	2.02	V
	V_I = 5 V		25°C	2.48	2.5	2.52	
	V_I = 40 V		25°C	19.8	20	20.2	
	V_I = 5 V		Full range	2.465		2.535	
Temperature coefficient of output voltage			Full range		25		ppm/°C
Supply current	No load	V_I = 5 V	25°C		170	300	μA
	No load	V_I = 4 to 40 V	Full range			400	
Output voltage regulation (sourcing current)‡	I_O = 0 to –10 mA		25°C		–45	±160	μV
	I_O = 0 to –10 mA		Full range			±250	
	I_O = 0 to –20 mA		25°C		–150	±450	
Output voltage regulation (sinking current)‡	I_O = 0 to 10 mA		25°C		15	±160	μV
	I_O = 0 to 3 mA		Full range			±250	
	I_O = 0 to 20 mA		25°C		65	±235	
Output impedance			25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	V_O = 5 V	25°C		26		mA
	Sourcing current,	V_O = 0	25°C		–47		
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0	25°C		120		μV
	f = 10 Hz to 10 kHz	C_{NR} = 1 μF	25°C		30		
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		290		μs
	V_O to 0.1%, I_O = ±10 mA	C_L = 100 pF	25°C		275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0	25°C		400		
	V_O to 0.01%, I_O = ±10 mA	C_L = 100 pF	25°C		390		
Step response	V_I = 0 to 5 V, V_O to 0.1%	C_L = 100 pF	25°C		20		μs
	V_I = 0 to 5 V, V_O to 0.01%	C_L = 100 pF	25°C		120		

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

electrical characteristics at specified free-air temperature, V_I = 12 V, I_O = 0 (unless otherwise noted)

PARAMETER	TEST CONDITIONS		T_A†	TLE2426M MIN	TLE2426M TYP	TLE2426M MAX	UNIT
Output voltage	V_I = 4 V		25°C	1.98	2	2.02	V
	V_I = 12 V			5.95	6	6.05	
	V_I = 40 V			19.8	20	20.2	
	V_I = 12 V		Full range	5.925		6.075	
Temperature coefficient of output voltage			Full range		35		ppm/°C
Supply current	No load	V_I = 12 V	25°C		195	250	μA
		V_I = 4 to 40 V	Full range			350	
Output voltage regulation (sourcing current)‡	I_O = 0 to –10 mA		25°C		–45	±160	μV
			Full range			±250	
	I_O = 0 to –20 mA		25°C		–150	±450	
Output voltage regulation (sinking current)‡	I_O = 0 to 10 mA		25°C		15	±160	μV
	I_O = 0 to 8 mA		Full range			±250	
	I_O = 0 to 20 mA		25°C		65	±235	
Output impedance			25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	V_O = 12 V	25°C		31		mA
	Sourcing current,	V_O = 0			–70		
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0	25°C		120		μV
		C_{NR} = 1 μF			30		
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0	25°C		290		μs
		C_L = 100 pF			275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0	25°C		400		
		C_L = 100 pF			390		
Step response	V_I = 0 to 12 V, V_O to 0.1%	C_L = 100 pF	25°C		12		μs
	V_I = 0 to 12 V, V_O to 0.01%				120		

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

electrical characteristics at specified free-air temperature, V_I = 5 V, I_O = 0, T_A = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS		TLE2426Y MIN	TLE2426Y TYP	TLE2426Y MAX	UNIT
Output voltage	V_I = 5 V			2.5		V
Supply current	No load			170		μA
Output voltage regulation (sourcing current)†	I_O = 0 to –10 mA			–45		μV
	I_O = 0 to –20 mA			–150		
Output voltage regulation (sinking current)†	I_O = 0 to 10 mA			15		μV
	I_O = 0 to 20 mA			65		
Output impedance				7.5		mΩ
Noise-reduction impedance				110		kΩ
Short-circuit current	Sinking current,	V_O = 5 V		26		mA
	Sourcing current,	V_O = 0		–47		
Output noise voltage, rms	f = 10 Hz to 10 kHz	C_{NR} = 0		120		μV
		C_{NR} = 1 μF		30		
Output voltage current step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0		290		μs
		C_L = 100 pF		275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0		400		
		C_L = 100 pF		390		
Step response	V_I = 0 to 5 V, V_O to 0.1%	C_L = 100 pF		20		μs
	V_I = 0 to 5 V, V_O to 0.01%			160		

† The listed values are not production tested.

electrical characteristics at specified free-air temperature, V_I = 12 V, I_O = 0, T_A = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS		TLE2426Y MIN	TLE2426Y TYP	TLE2426Y MAX	UNIT
Output voltage	V_I = 12 V			6		V
Supply current	No load			195		μA
Output voltage regulation (sourcing current)†	I_O = 0 to –10 mA			–45		μV
	I_O = 0 to –20 mA			–150		
Output voltage regulation (sinking current)†	I_O = 0 to 3 mA			15		μV
	I_O = 0 to 20 mA			65		
Output impedance				7.5		mΩ
Noise-reduction impedance				110		kΩ
Short-circuit current	Sinking current,	V_O = 12 V		31		mA
	Sourcing current,	V_O = 0		–70		
Output noise voltage, rms	f = 10 Hz to 10 kHZ	C_{NR} = 0		120		μV
		C_{NR} = 1 μF		30		
Output voltage current, step response	V_O to 0.1%, I_O = ±10 mA	C_L = 0		290		μs
		C_L = 100 pF		275		
	V_O to 0.01%, I_O = ±10 mA	C_L = 0		400		
		C_L = 100 pF		390		
Step response	V_I = 0 to 12 V, V_O to 0.1%	C_L = 100 pF		12		μs
	V_I = 0 to 12 V, V_O to 0.01%			120		

† The listed values are not production tested.

TYPICAL CHARACTERISTICS

Table Of Graphs

		FIGURE
Output voltage	Distribution	1,2
Output voltage change	vs Free-air temperature	3
Output voltage error	vs Input voltage	4
Input bias current	vs Input voltage	5
	vs Free-air temperature	6
Output voltage regulation	vs Output current	7
Output impedance	vs Frequency	8
Short-circuit output current	vs Input voltage	9,10
	vs Free-air temperature	11,12
Ripple rejection	vs Frequency	13
Spectral noise voltage density	vs Frequency	14
Output voltage response to output current step	vs Time	15
Output voltage power-up response	vs Time	16
Output current	vs Load capacitance	17

TYPICAL CHARACTERISTICS†

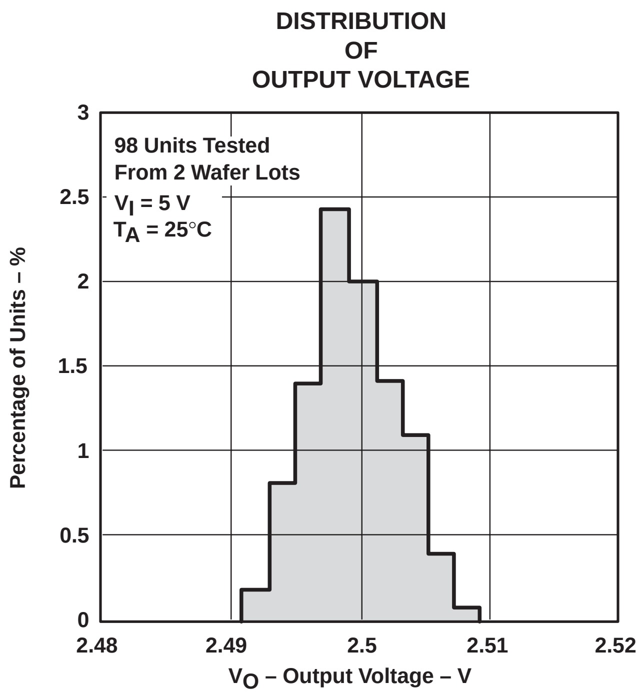


Figure 1

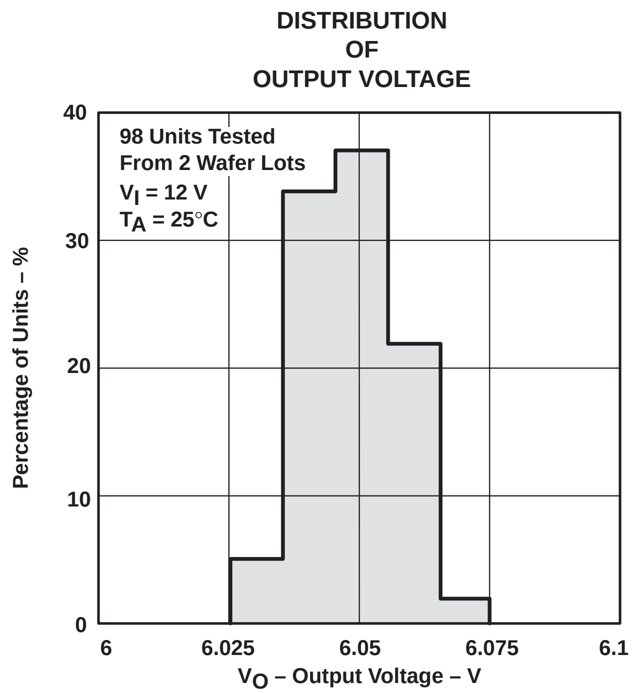


Figure 2

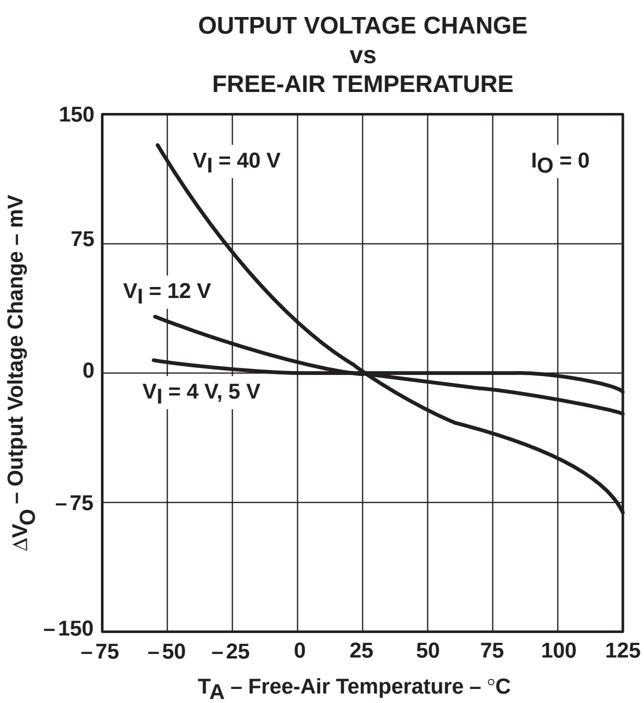


Figure 3

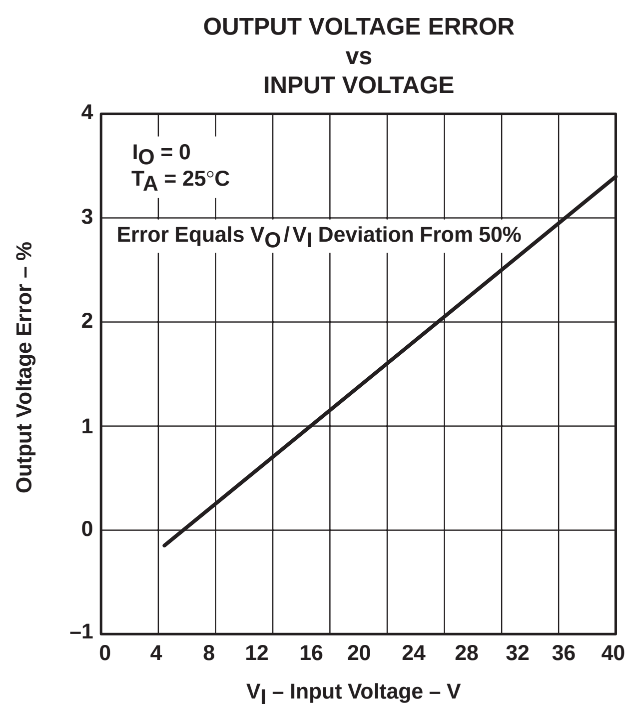


Figure 4

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

TYPICAL CHARACTERISTICS†

INPUT BIAS CURRENT
vs
INPUT VOLTAGE

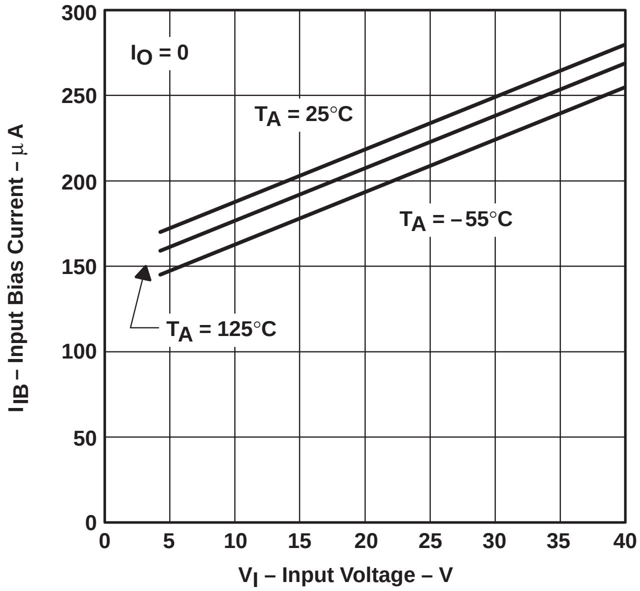


Figure 5

INPUT BIAS CURRENT
vs
FREE-AIR TEMPERATURE

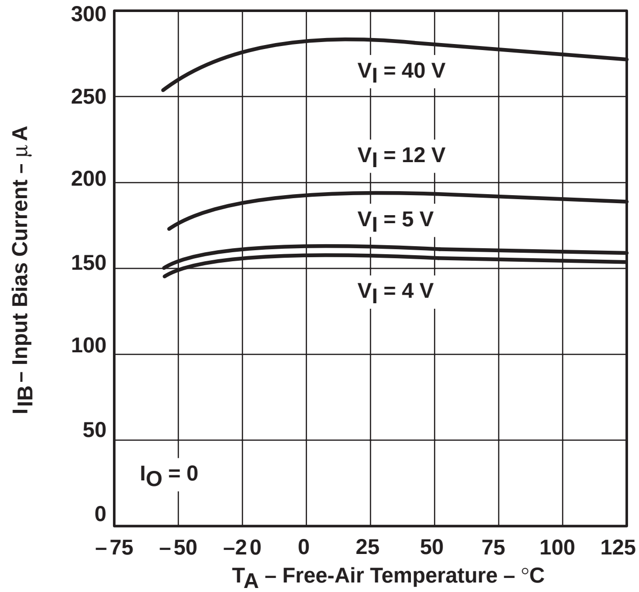


Figure 6

OUTPUT VOLTAGE REGULATION
vs
OUTPUT CURRENT

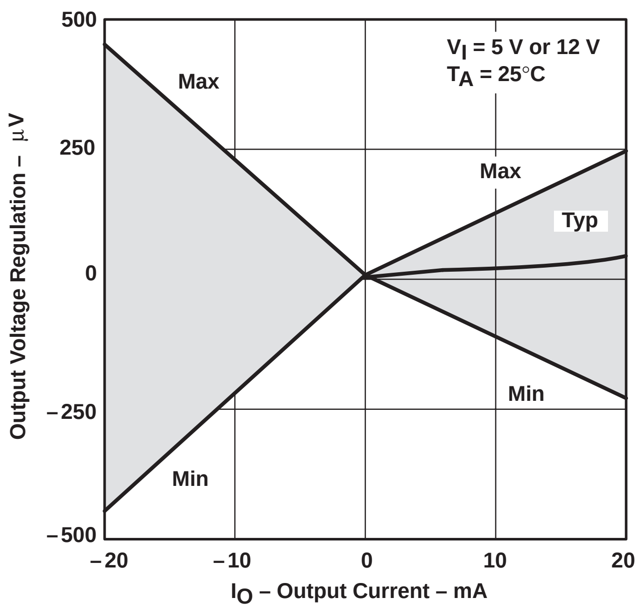


Figure 7

OUTPUT IMPEDANCE
vs
FREQUENCY

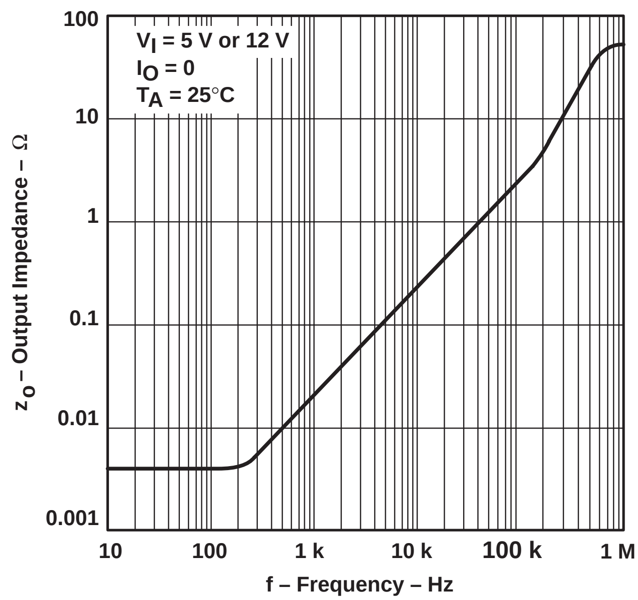


Figure 8

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

TYPICAL CHARACTERISTICS†

SHORT-CIRCUIT OUTPUT CURRENT vs INPUT VOLTAGE

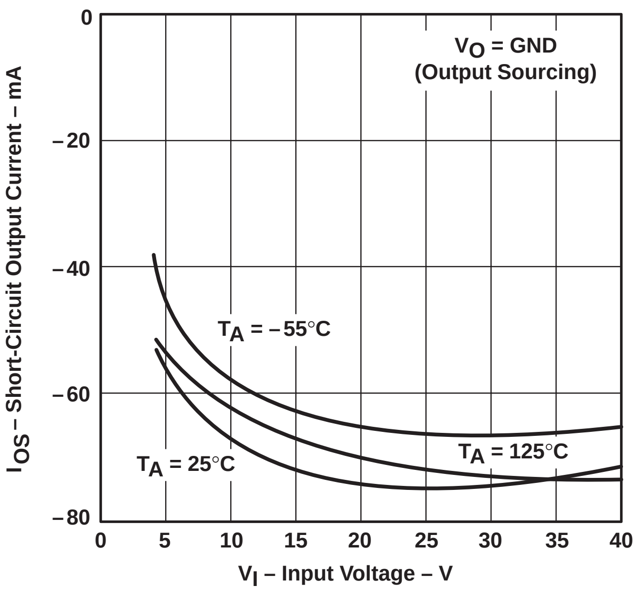


Figure 9

SHORT-CIRCUIT OUTPUT CURRENT vs INPUT VOLTAGE

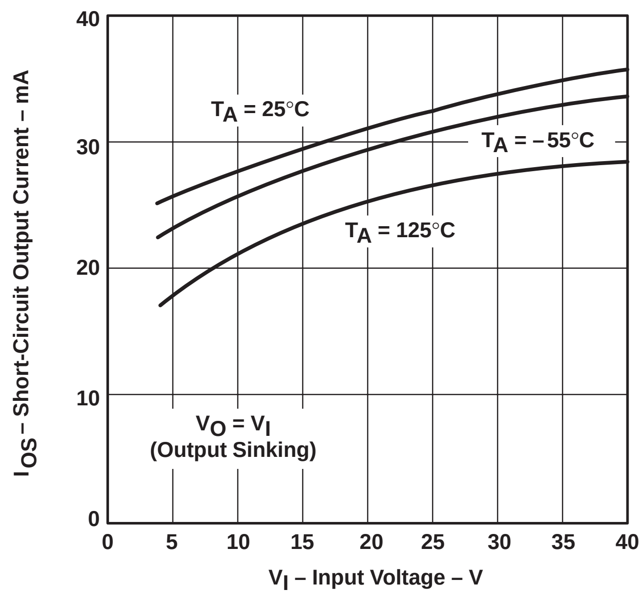


Figure 10

SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE

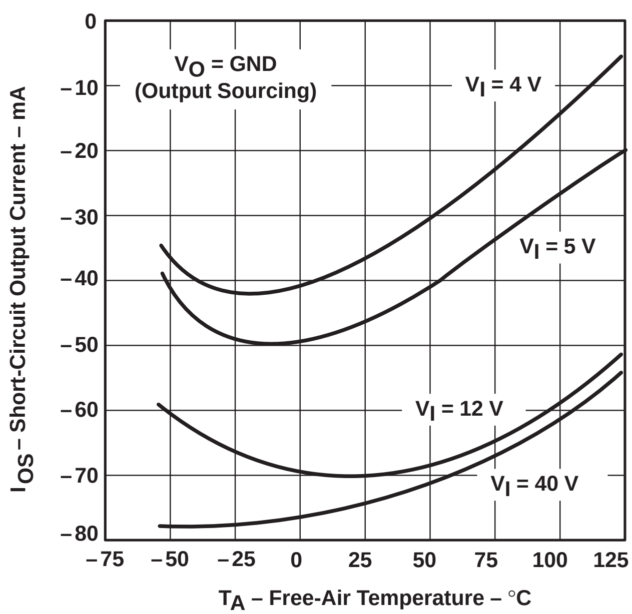


Figure 11

SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE

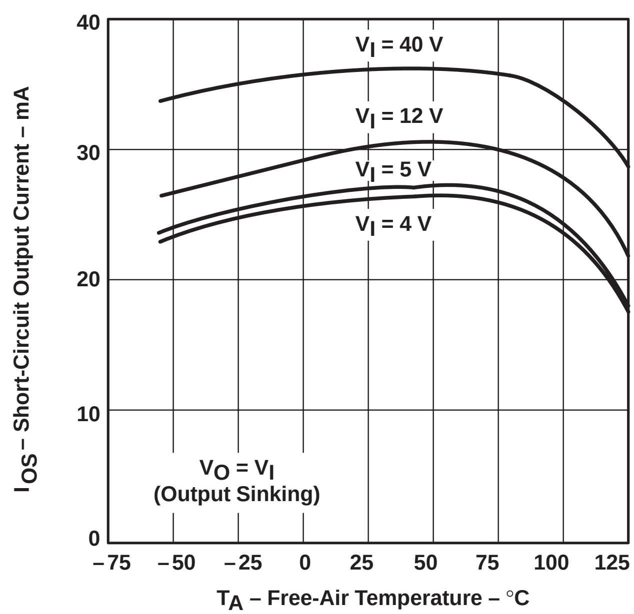


Figure 12

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

TYPICAL CHARACTERISTICS

RIPPLE REJECTION vs FREQUENCY

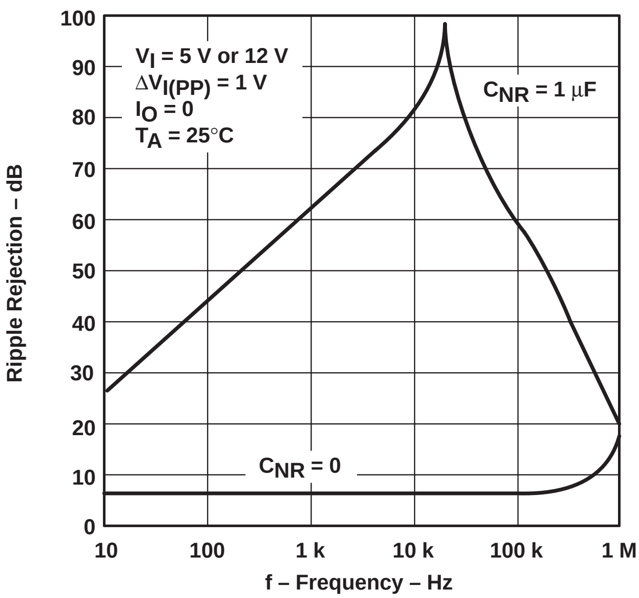


Figure 13

SPECTRAL NOISE VOLTAGE DENSITY vs FREQUENCY

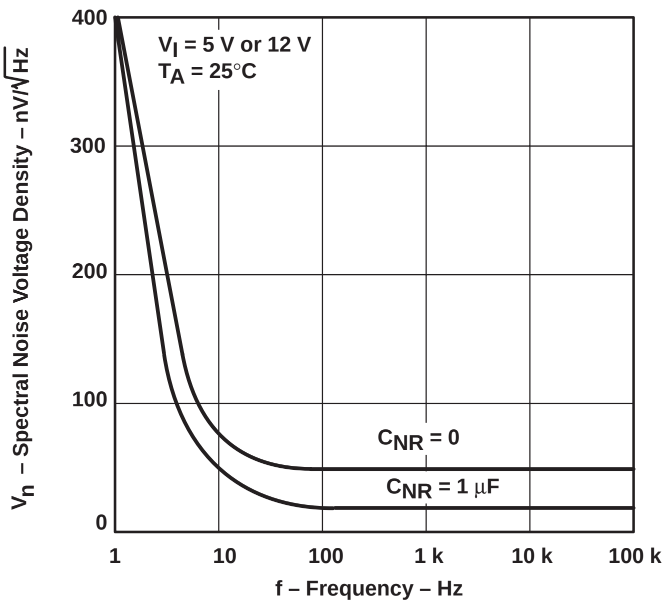


Figure 14

OUTPUT VOLTAGE RESPONSE TO OUTPUT CURRENT STEP

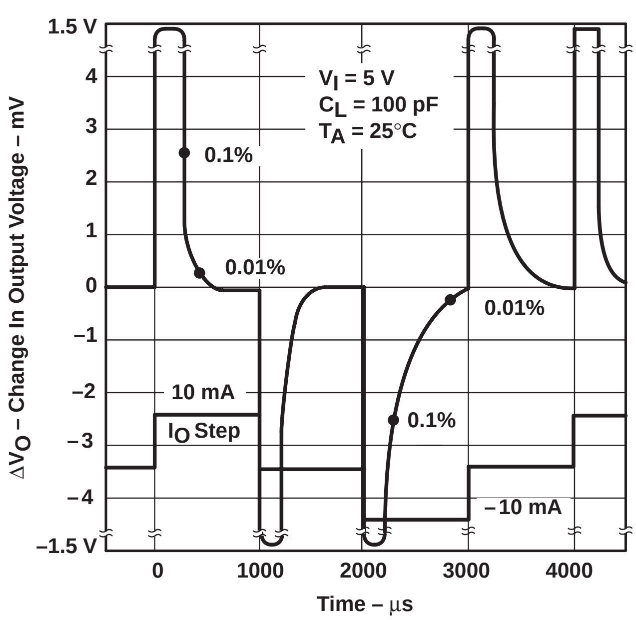


Figure 15

OUTPUT VOLTAGE POWER-UP RESPONSE

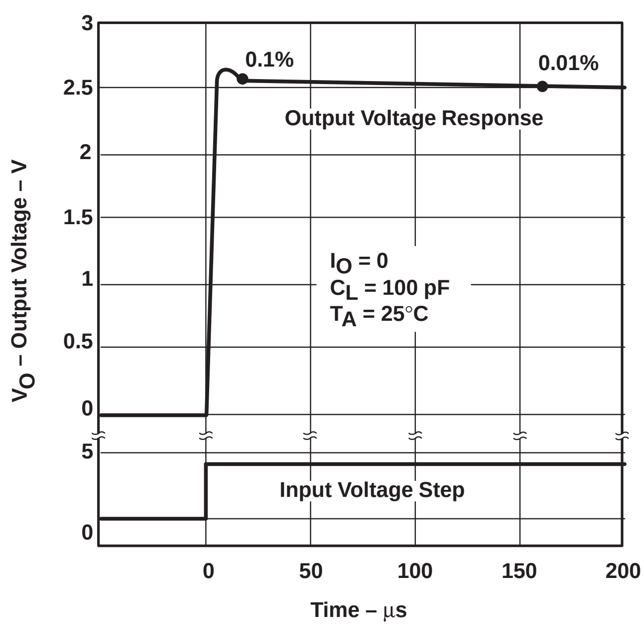


Figure 16

TYPICAL CHARACTERISTICS

STABILITY RANGE
OUTPUT CURRENT
vs
LOAD CAPACITANCE

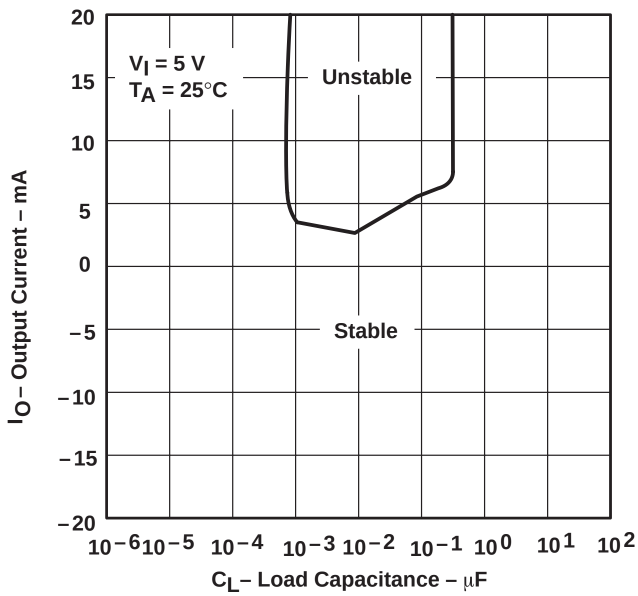


Figure 17

MACROMODEL INFORMATION

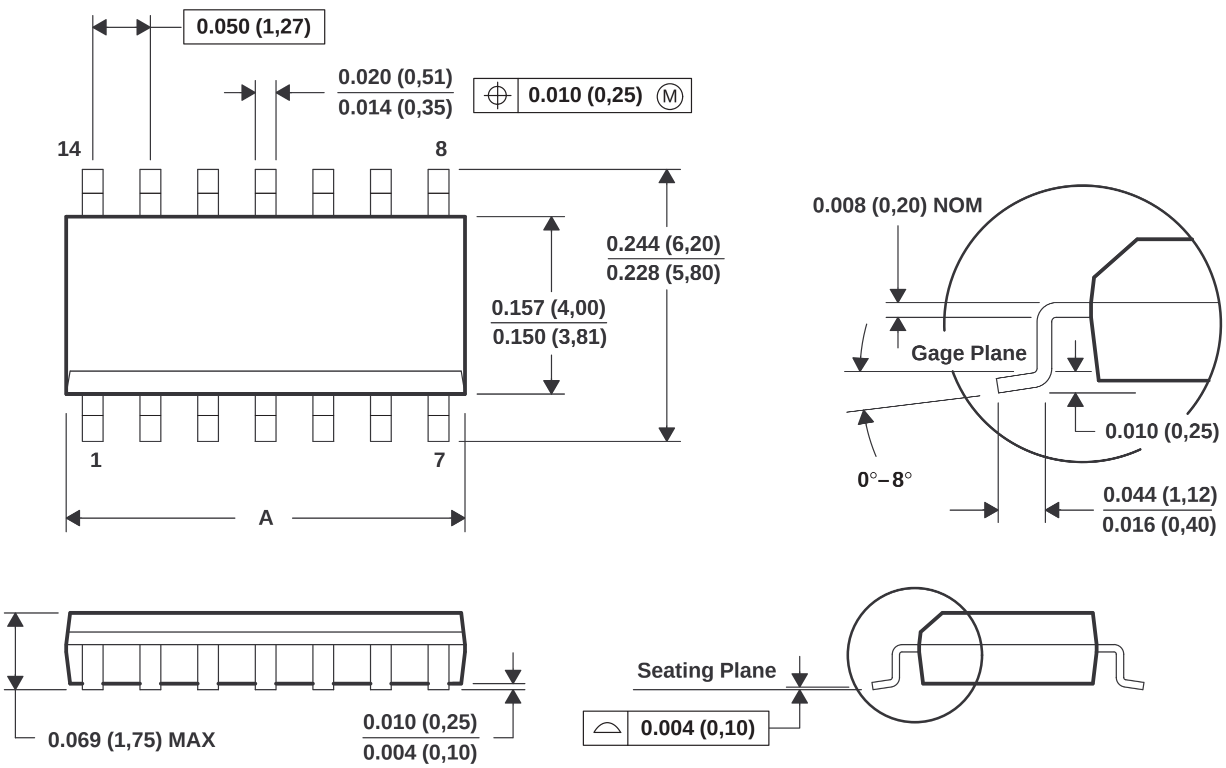
```
*   TLE2426 OPERATIONAL AMPLIFIER “MACROMODEL” SUBCIRCUIT
*   CREATED USING PARTS RELEASE 4.03 0N 08/21/90 AT 13:51
*   REV (N/A)     SUPPLY VOLTAGE: 5 V
*   CONNECTIONS:      FILTER
                      |   INPUT
*                     |   |   COMMON
*                     |   |   |   OUTPUT
*                     |   |   |   |
.SUBCKT TLE2426       1   3   4   5
```

```
    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
    DLP     90  91  DX
    DLN     92  90  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
    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
    RIN1     3   1  220K
    RIN2     1   4  220K
.MODEL DX  D(IS=800.OE–18)
.MODEL QX  PNP(IS=800.OE–18 BF=480)
.ENDS
```

MECHANICAL INFORMATION

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

14 PIN SHOWN



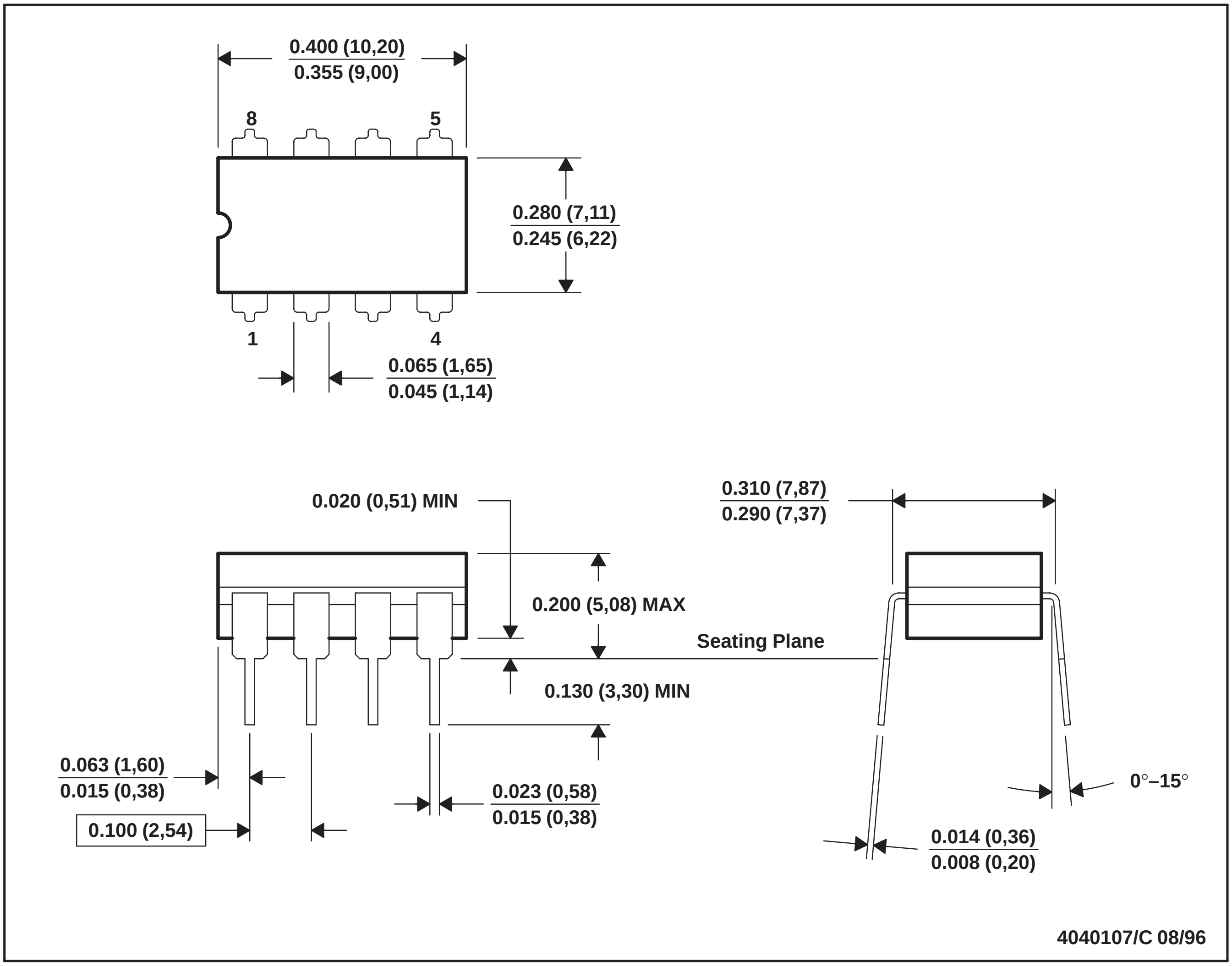
PINS ** / DIM	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

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 INFORMATION

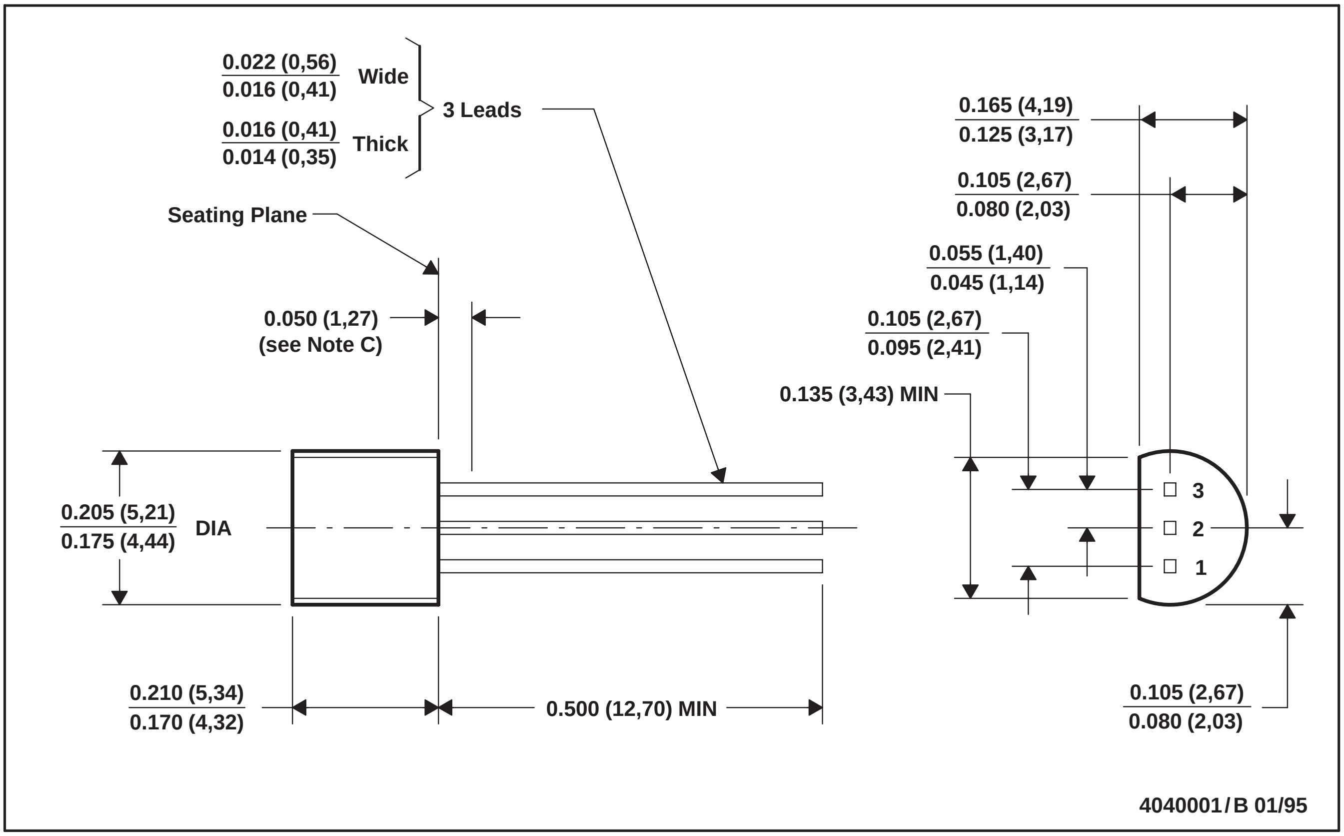
JG (R-GDIP-T8) **CERAMIC DUAL-IN-LINE PACKAGE**



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 only on press ceramic glass frit seal only.
E. Falls within MIL-STD-1835 GDIP1-T8

MECHANICAL INFORMATION

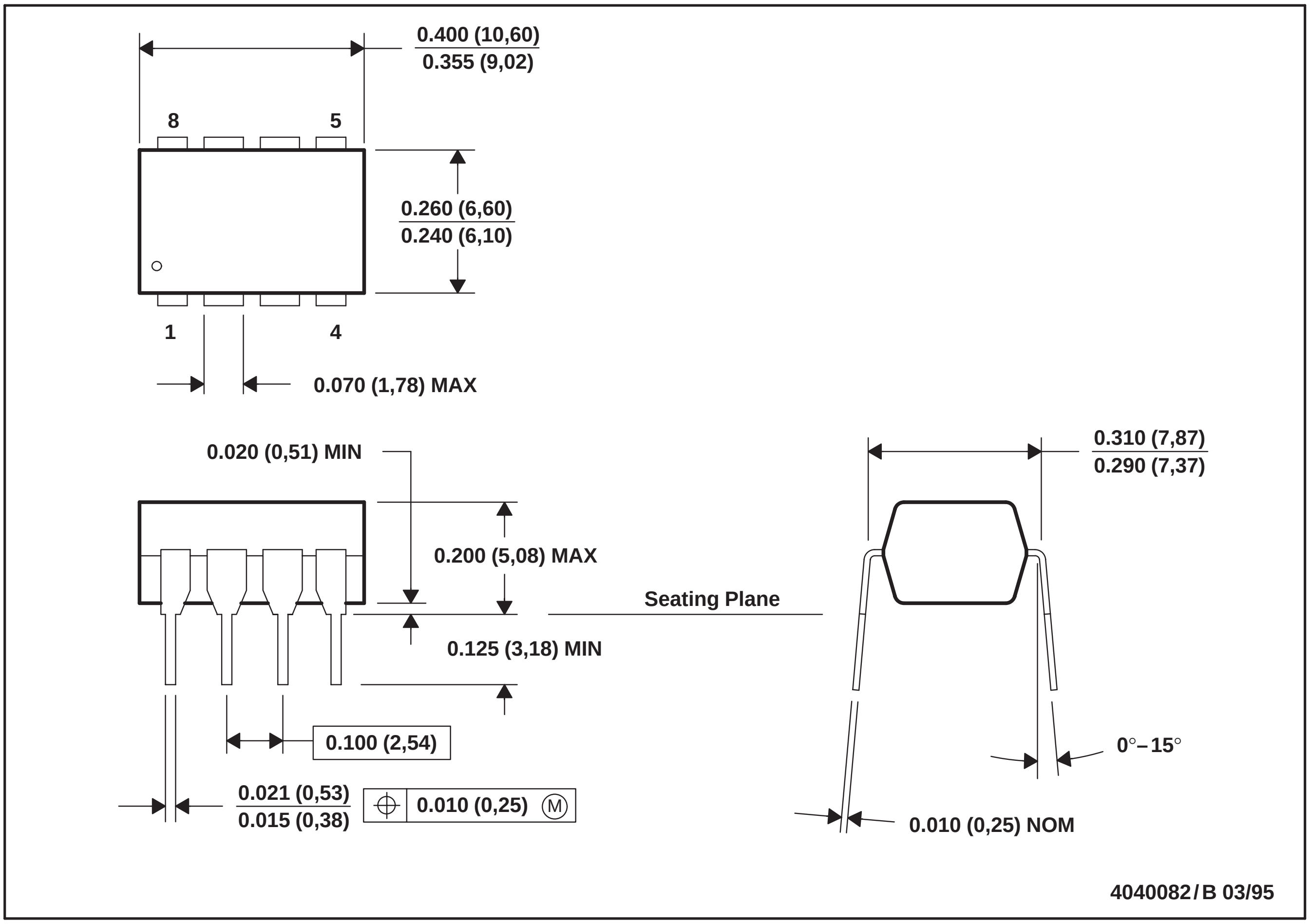
LP (O-PBCY-W3) **PLASTIC CYLINDRICAL PACKAGE**



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-226AA (TO-226AA replaces TO-92)

MECHANICAL INFORMATION

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

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

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

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.