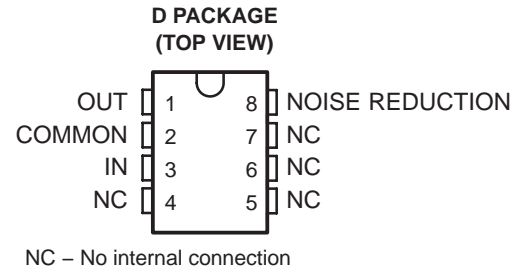


- **Qualified for Automotive Applications**
- **1/2 V_I Virtual Ground for Analog Systems**
- **Micropower Operation . . . 170 μ A Typ, $V_I = 5$ V**
- **Wide V_I Range . . . 4 V to 40 V**
- **High Output-Current Capability**
 - Source . . . 20 mA Typ
 - Sink . . . 20 mA Typ
- **Excellent Output Regulation**
 - -102μ V Typ at $I_O = 0$ to -10 mA
 - $+49 \mu$ V Typ at $I_O = 0$ to $+10$ mA
- **Low-Impedance Output . . . 0.0075 Ω Typ**
- **Noise Reduction Pin**



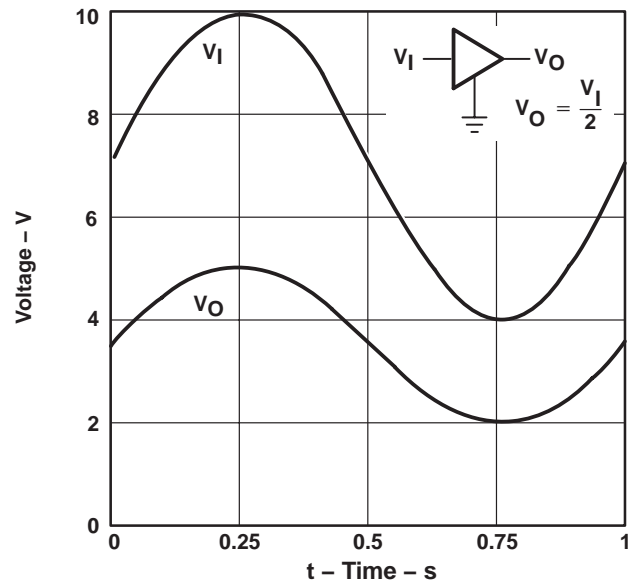
description

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 μ A 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. For increased performance, the 8-pin package provides 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% 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.

INPUT/OUTPUT TRANSFER CHARACTERISTICS



ORDERING INFORMATION†

T _A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOIC (D)	Tape and Reel	TLE2426QDRQ1	2426Q1

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.



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.

TLE2426-Q1
THE “RAIL SPLITTER”
PRECISION VIRTUAL GROUND

SGLS252A – AUGUST 2004 – REVISED JUNE 2008

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 : Q suffix	-40°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

† 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	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D	1102 mW	10.3 mW/°C	638.5 mW	484 mW	72.1 mW

recommended operating conditions

	MIN	MAX	UNIT
Input voltage, V_I	4	40	V
Operating free-air temperature, T_A	-40	125	°C



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

PARAMETER	TEST CONDITIONS		T_A^\dagger	MIN	TYP	MAX	UNIT
Output voltage	$V_I = 4\text{ V}$		25°C	1.98	2	2.02	V
	$V_I = 5\text{ V}$			2.48	2.5	2.52	
	$V_I = 40\text{ V}$			19.8	20	20.2	
	$V_I = 5\text{ V}$		Full range	2.465		2.535	
Temperature coefficient of output voltage			Full range	25			ppm/°C
Supply current	No load	$V_I = 5\text{ V}$	25°C	170	300		µA
		$V_I = 4\text{ to }40\text{ V}$	Full range	400			
Output voltage regulation (sourcing current) [‡]	$I_O = 0\text{ to }-10\text{ mA}$		25°C	-0.102	±0.7		mV
			Full range	±10			
Output voltage regulation (sinking current) [‡]	$I_O = 0\text{ to }-20\text{ mA}$		25°C	-0.121	±1.4		mV
			Full range	±10			
Output voltage regulation (sinking current) [‡]	$I_O = 0\text{ to }10\text{ mA}$		25°C	0.049	±0.5		mV
	$I_O = 0\text{ to }8\text{ mA}$		Full range	±10			
	$I_O = 0\text{ to }20\text{ mA}$		25°C	0.175	±1.4		
Output impedance [‡]			25°C	7.5	22.5		mΩ
Noise-reduction impedance			25°C	110			kΩ
Short-circuit current	Sinking current,	$V_O = 5\text{ V}$	25°C	26			mA
	Sourcing current,	$V_O = 0$		-47			
Output noise voltage, rms	$f = 10\text{ Hz to }10\text{ kHz}$	$C_{NR} = 0$	25°C	120			µV
		$C_{NR} = 1\text{ µF}$		30			
Output voltage current step response	$V_O\text{ to }0.1\%$, $I_O = \pm 10\text{ mA}$	$C_L = 0$	25°C	290			µs
		$C_L = 100\text{ pF}$		275			
	$V_O\text{ to }0.01\%$, $I_O = \pm 10\text{ mA}$	$C_L = 0$	25°C	400			
		$C_L = 100\text{ pF}$		390			
Step response	$V_I = 0\text{ to }5\text{ V}$, $V_O\text{ to }0.1\%$		25°C	20			µs
	$V_I = 0\text{ to }5\text{ V}$, $V_O\text{ to }0.01\%$			120			

[†] Full range is -40°C to 125°C.

[‡] The listed values are not production tested.

TLE2426-Q1
THE “RAIL SPLITTER”
PRECISION VIRTUAL GROUND

SGLS252A – AUGUST 2004 – REVISED JUNE 2008

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

PARAMETER	TEST CONDITIONS		T_A †	MIN	TYP	MAX	UNIT
Output voltage	$V_I = 4\text{ V}$		25°C	1.98	2	2.02	V
	$V_I = 12\text{ V}$			5.95	6	6.05	
	$V_I = 40\text{ V}$			19.8	20	20.2	
	$V_I = 12\text{ V}$		Full range	5.925		6.075	
Temperature coefficient of output voltage			Full range		35		ppm/°C
Supply current	No load	$V_I = 12\text{ V}$	25°C		195	300	µA
		$V_I = 4\text{ to }40\text{ V}$	Full range			400	
Output voltage regulation (sourcing current)‡	$I_O = 0\text{ to }-10\text{ mA}$		25°C		-1.48	±10	mV
			Full range			±10	
Output voltage regulation (sinking current)‡	$I_O = 0\text{ to }-20\text{ mA}$		25°C		-3.9	±10	mV
	$I_O = 0\text{ to }10\text{ mA}$		25°C		2.27	±10	
	$I_O = 0\text{ to }8\text{ mA}$		Full range			±10	
Output impedance‡	$I_O = 0\text{ to }20\text{ mA}$		25°C		7.5	22.5	mΩ
Noise-reduction impedance			25°C		110		kΩ
Short-circuit current	Sinking current,	$V_O = 12\text{ V}$	25°C		31		mA
	Sourcing current,	$V_O = 0$			-70		
Output noise voltage, rms	$f = 10\text{ Hz to }10\text{ kHz}$	$C_{NR} = 0$	25°C		120		µV
		$C_{NR} = 1\text{ µF}$			30		
Output voltage current step response	$V_O\text{ to }0.1\%$, $I_O = \pm 10\text{ mA}$	$C_L = 0$	25°C		290		µs
		$C_L = 100\text{ pF}$			275		
	$V_O\text{ to }0.01\%$, $I_O = \pm 10\text{ mA}$	$C_L = 0$	25°C		400		
		$C_L = 100\text{ pF}$			390		
Step response	$V_I = 0\text{ to }12\text{ V}$, $V_O\text{ to }0.1\%$		25°C		12		µs
	$V_I = 0\text{ to }12\text{ V}$, $V_O\text{ to }0.01\%$					120	

† Full range is -40°C to 125°C.

‡ 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†

DISTRIBUTION OF OUTPUT VOLTAGE

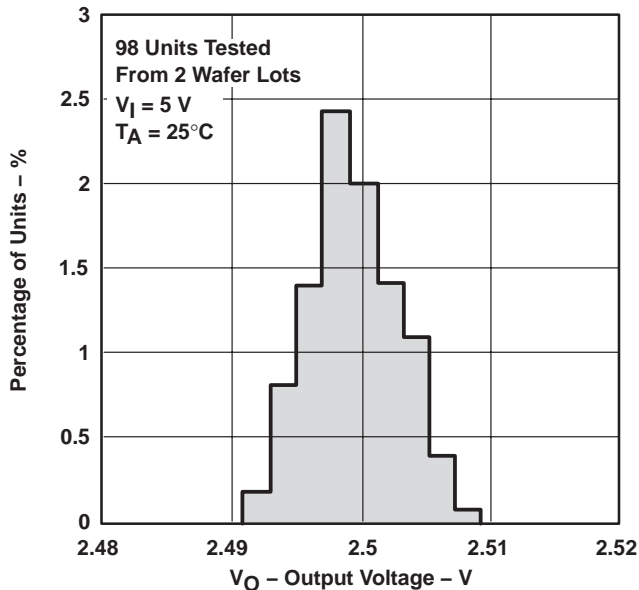


Figure 1

DISTRIBUTION OF OUTPUT VOLTAGE

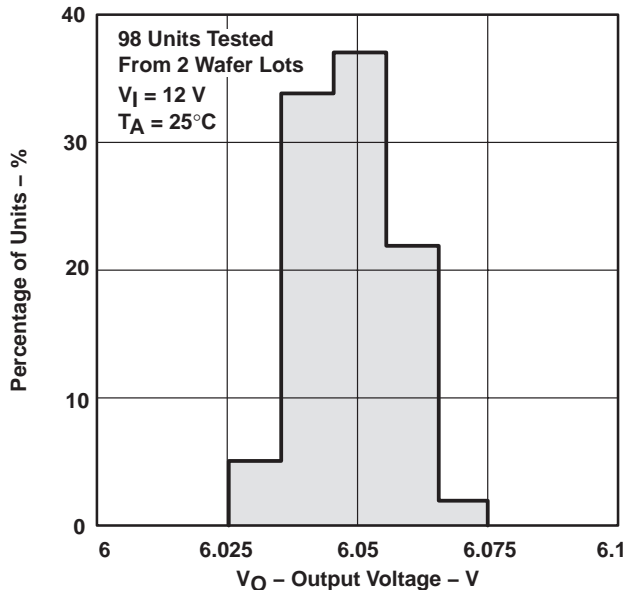


Figure 2

OUTPUT VOLTAGE CHANGE vs FREE-AIR TEMPERATURE

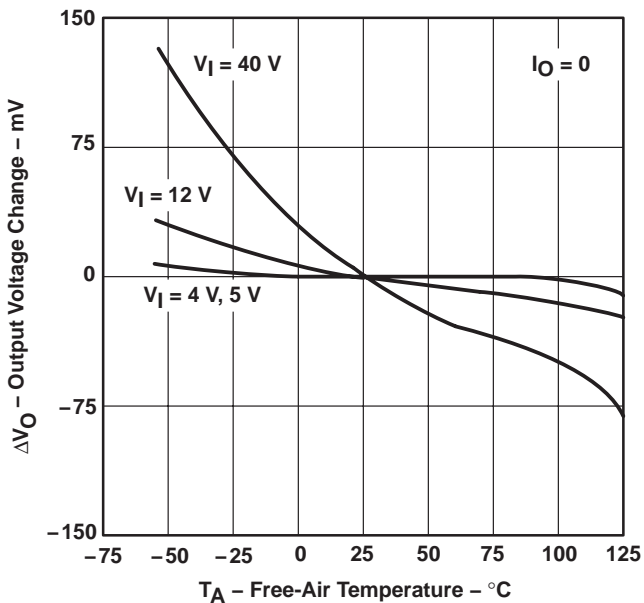


Figure 3

OUTPUT VOLTAGE ERROR vs INPUT VOLTAGE

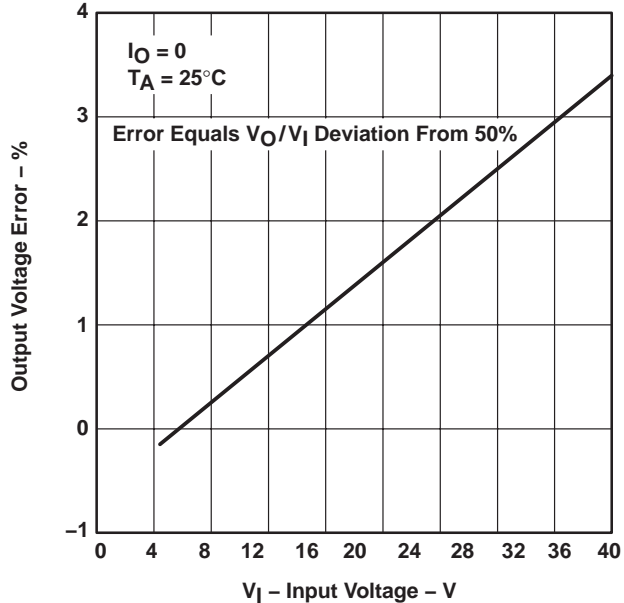
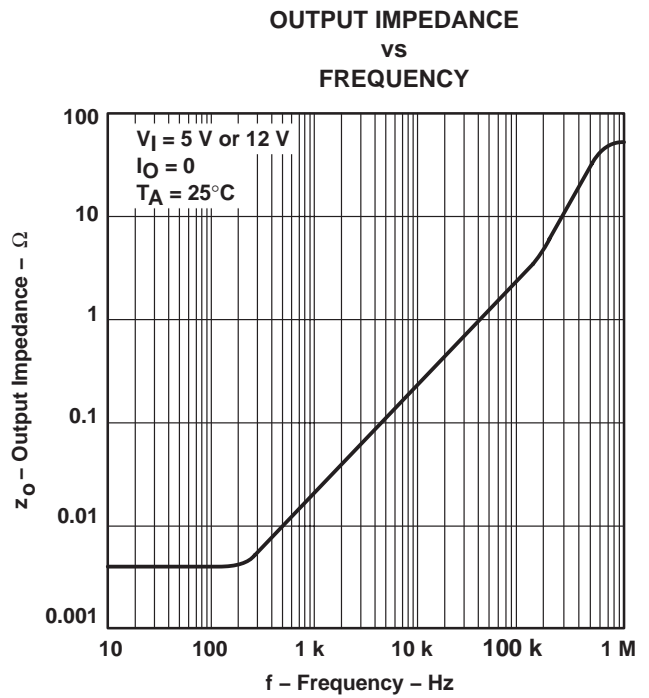
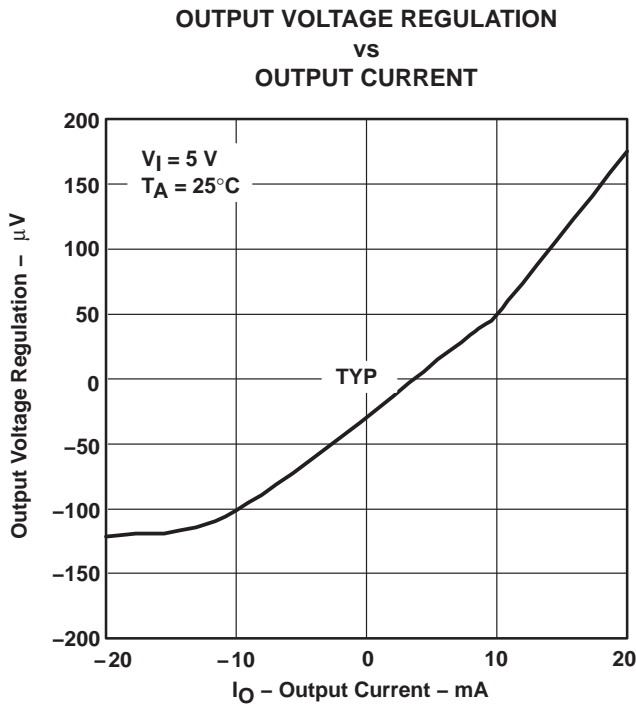
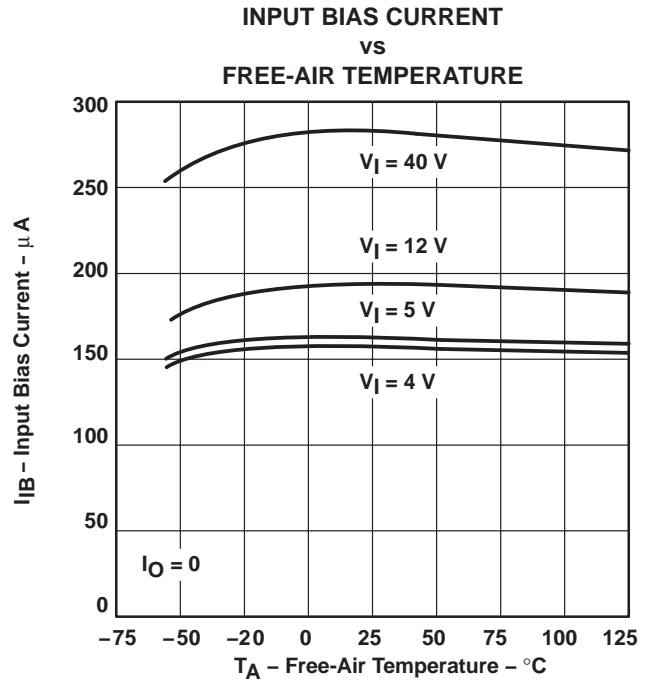
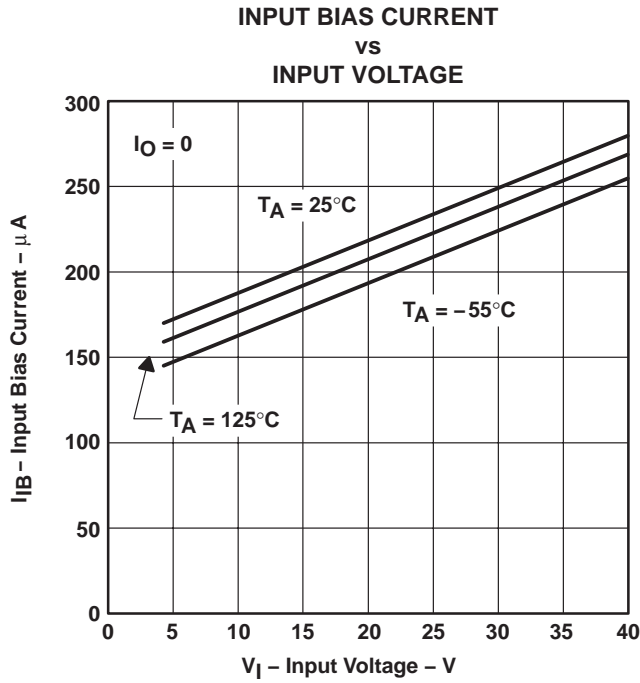


Figure 4

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

TYPICAL CHARACTERISTICS†



† 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**

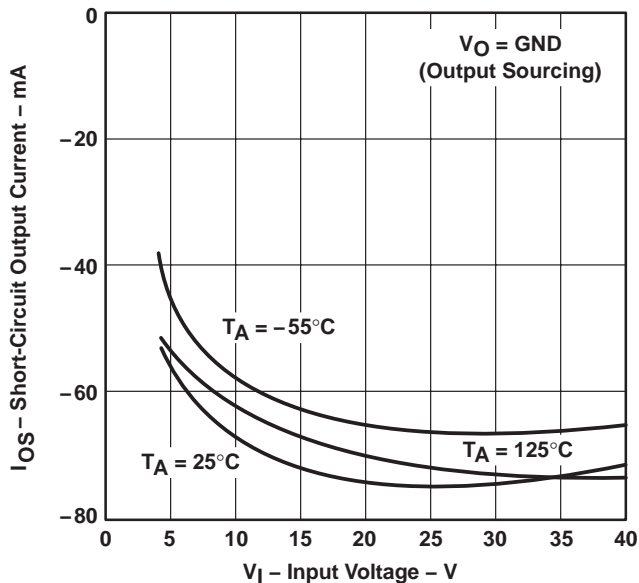


Figure 9

**SHORT-CIRCUIT OUTPUT CURRENT
 VS
 INPUT VOLTAGE**

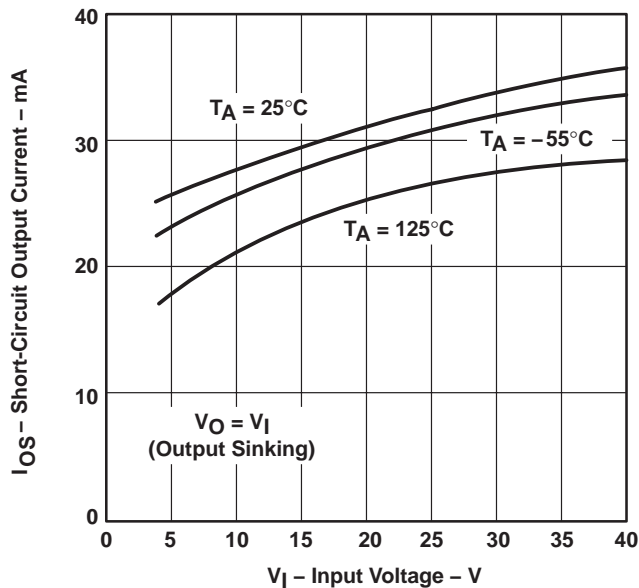


Figure 10

**SHORT-CIRCUIT OUTPUT CURRENT
 VS
 FREE-AIR TEMPERATURE**

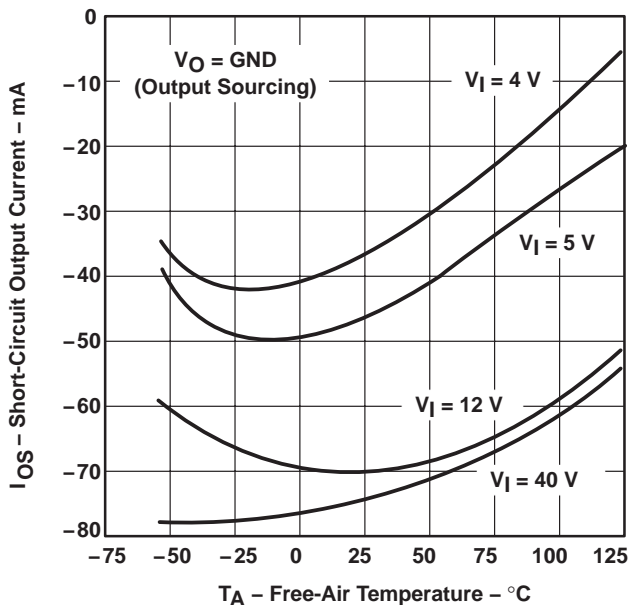


Figure 11

**SHORT-CIRCUIT OUTPUT CURRENT
 VS
 FREE-AIR TEMPERATURE**

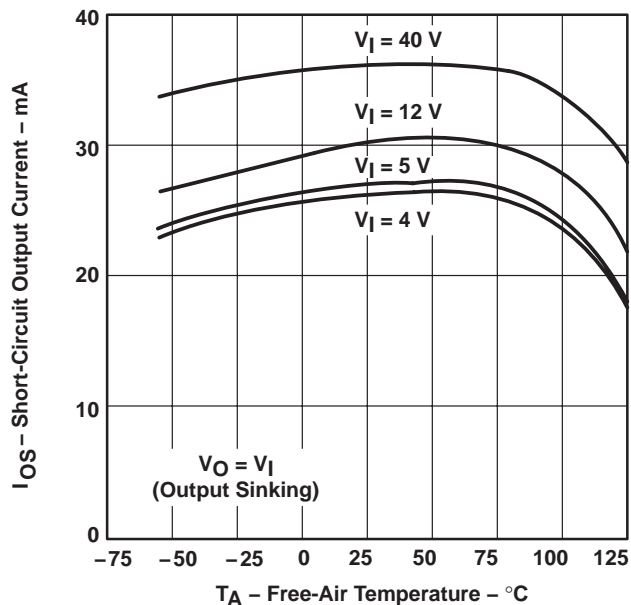


Figure 12

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

TYPICAL CHARACTERISTICS

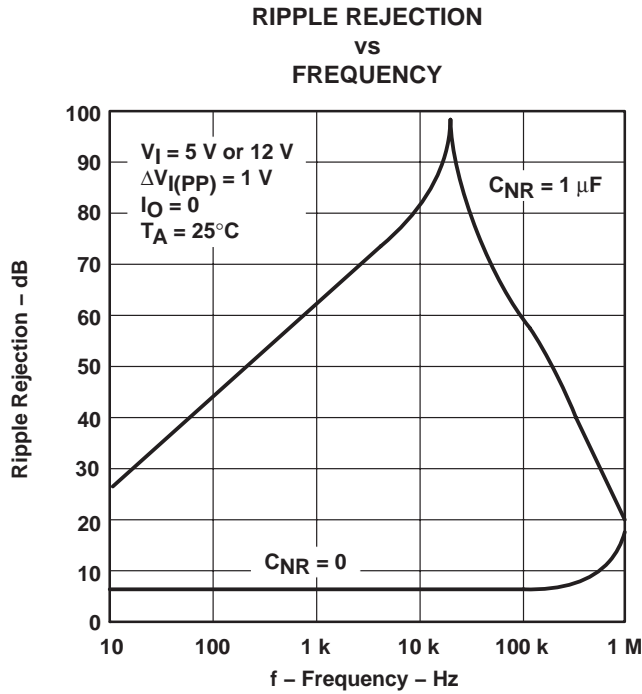


Figure 13

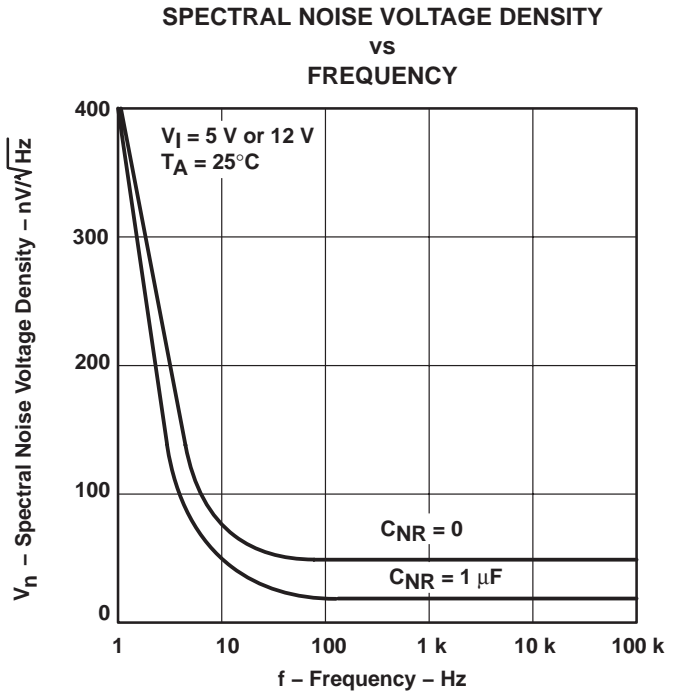


Figure 14

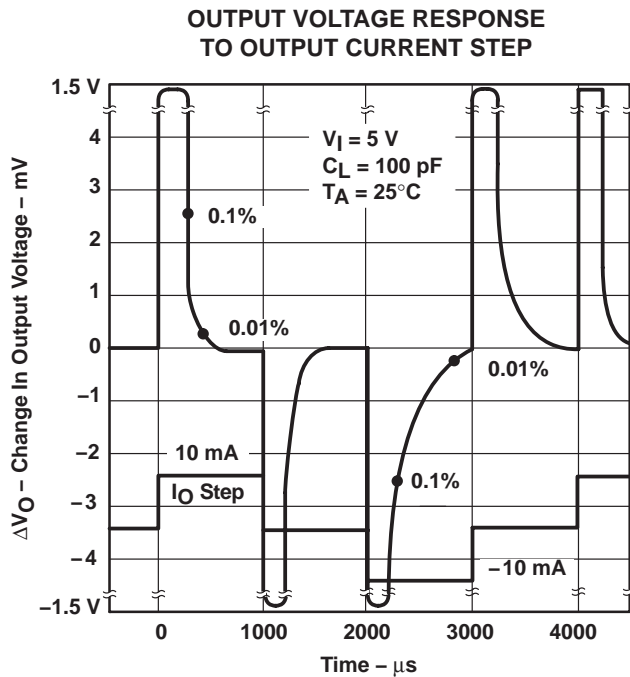


Figure 15

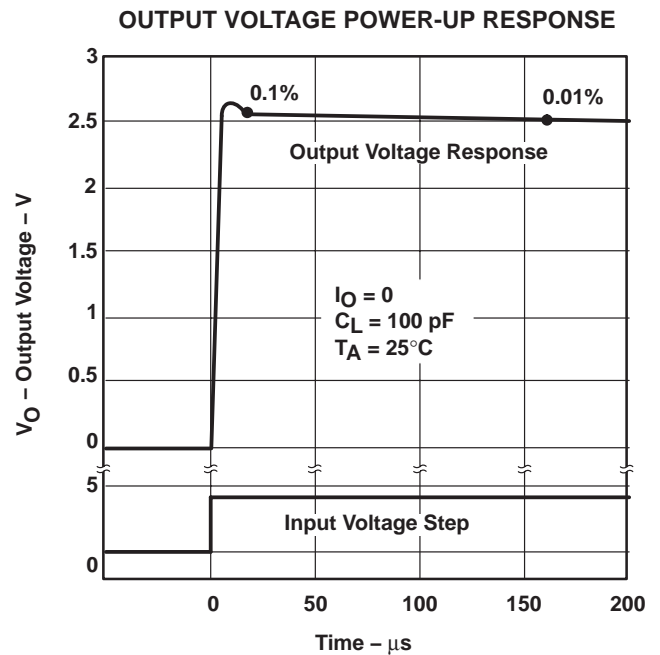


Figure 16

TYPICAL CHARACTERISTICS

**STABILITY RANGE
OUTPUT CURRENT
vs
LOAD CAPACITANCE**

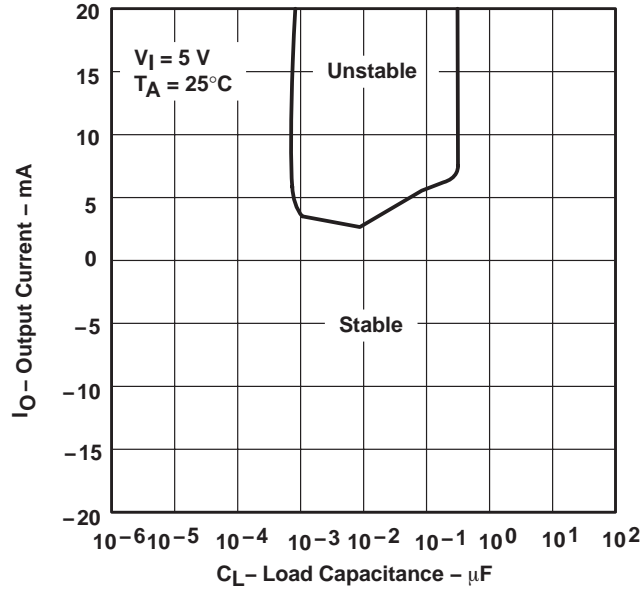


Figure 17

MACROMODEL INFORMATION

```

* TLE2426 OPERATIONAL AMPLIFIER "MACROMODEL" SUBCIRCUIT
* CREATED USING PARTS RELEASE 4.03 ON 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
  
```



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
TLE2426QDRG4Q1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
TLE2426QDRQ1	OBSOLETE	SOIC	D	8		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.

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OTHER QUALIFIED VERSIONS OF TLE2426-Q1 :

● Catalog: [TLE2426](#)

● Enhanced Product: [TLE2426-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

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