

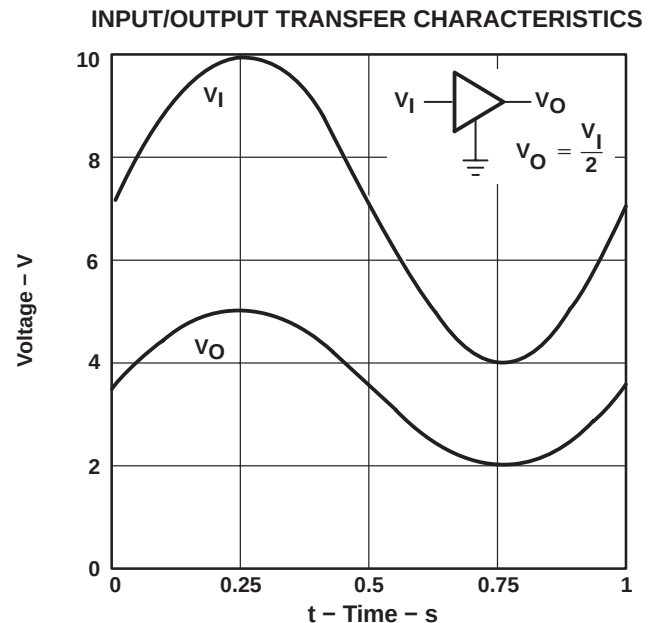
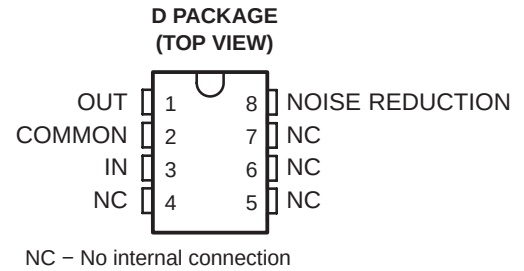
- Qualified for Automotive Applications
- 1/2 V_I Virtual Ground for Analog Systems
- Micropower Operation . . . 170 μ A Typ,
 $V_I = 5$ V
- Wide V_I Range . . . 4 V to 40 V
- High Output-Current Capability
 - Source . . . 20 mA Typ
 - Sink . . . 20 mA Typ
- Excellent Output Regulation
 - -102μ V Typ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



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.

TEXAS
INSTRUMENTS

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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 [†]	MIN	TYP	MAX	UNIT
Output voltage	V _I = 4 V		25°C	1.98	2	2.02	V
	V _I = 5 V			2.48	2.5	2.52	
	V _I = 40 V			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	
		V _I = 4 to 40 V	Full range	400			
Output voltage regulation (sourcing current) [‡]	I _O = 0 to −10 mA		25°C	−0.102	±0.7	mV	
			Full range	±10			
	I _O = 0 to −20 mA		25°C	−0.121	±1.4		
Output voltage regulation (sinking current) [‡]	I _O = 0 to 10 mA		25°C	0.049	±0.5	mV	
	I _O = 0 to 8 mA		Full range	±10			
	I _O = 0 to 20 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 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%			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 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	300		µA
		V _I = 4 to 40 V	Full range	400			
Output voltage regulation (sourcing current) [‡]	I _O = 0 to −10 mA		25°C	−1.48	±10		mV
			Full range	±10			
	I _O = 0 to −20 mA		25°C	−3.9	±10		
Output voltage regulation (sinking current) [‡]	I _O = 0 to 10 mA		25°C	2.27	±10		mV
	I _O = 0 to 8 mA		Full range	±10			
	I _O = 0 to 20 mA		25°C	4.3	±10		
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 -40°C to 125°C.

[‡] The listed values are not production tested.



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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†

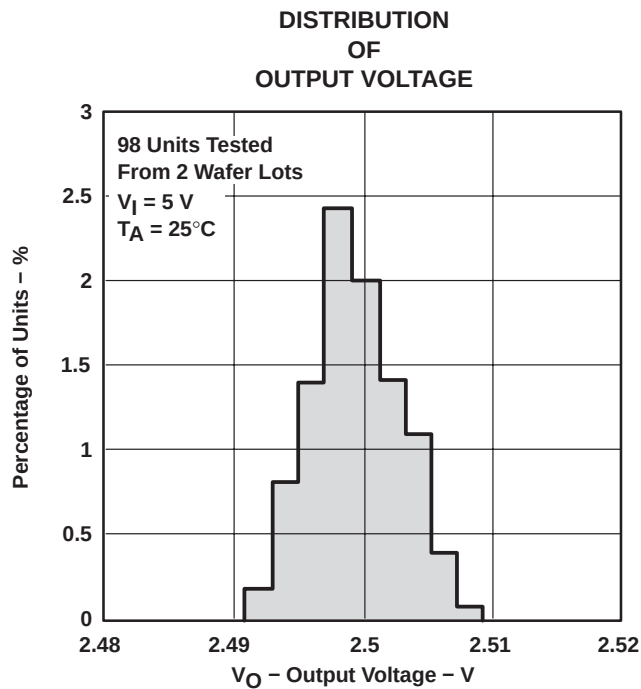


Figure 1

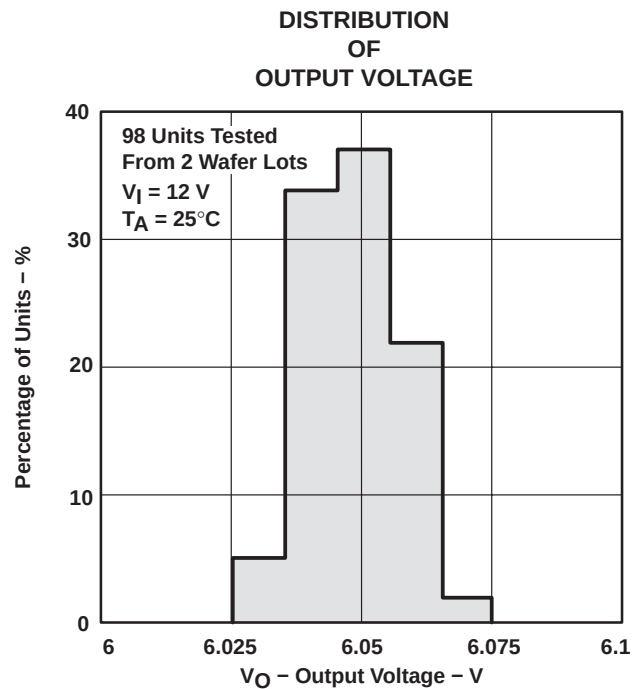


Figure 2

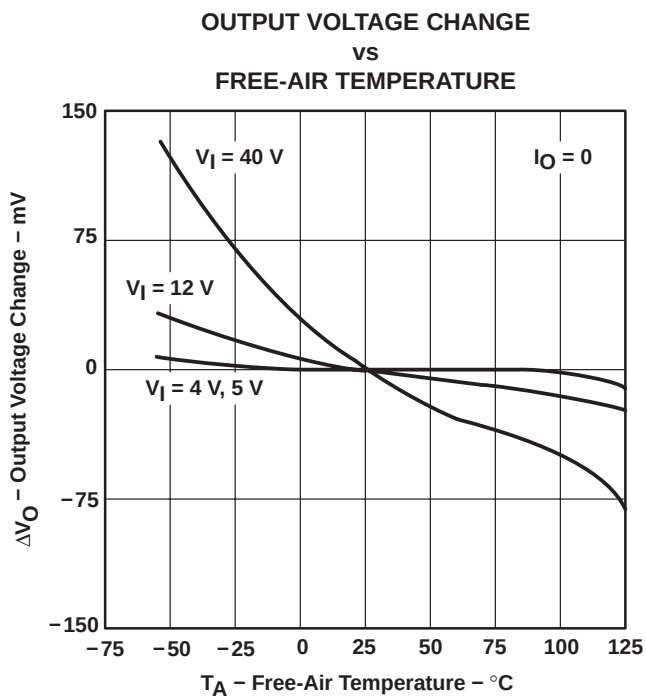


Figure 3

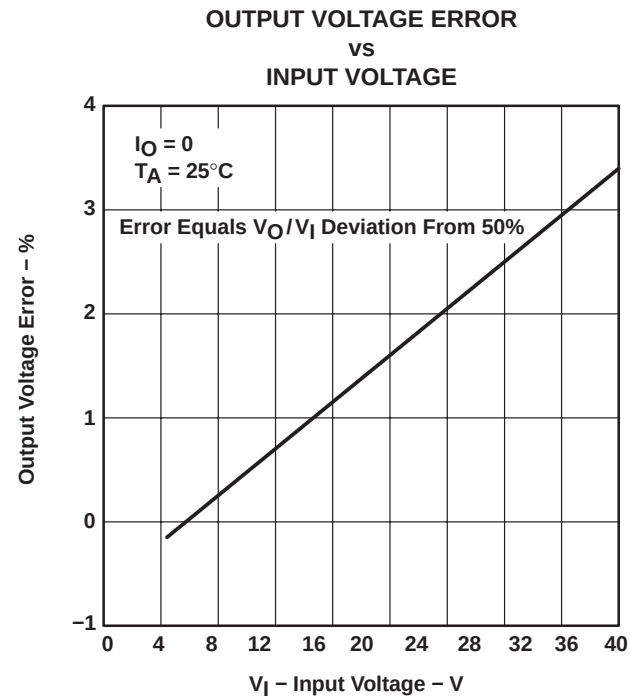
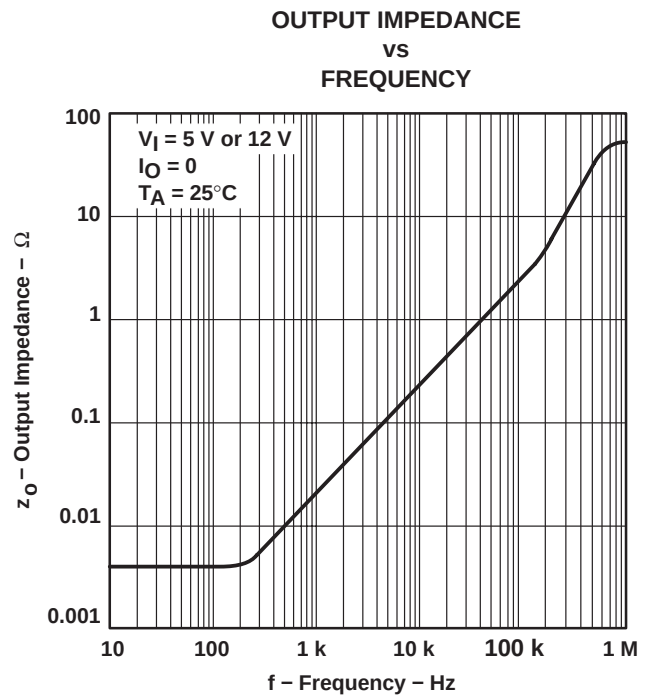
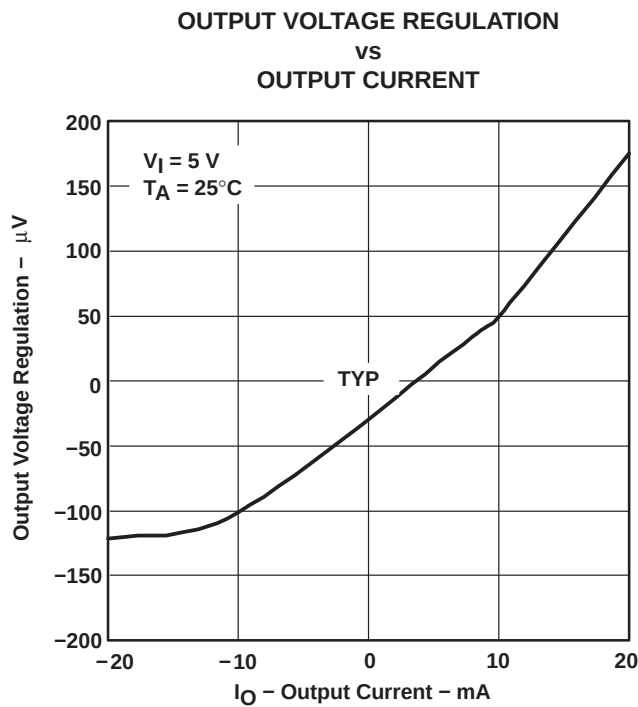
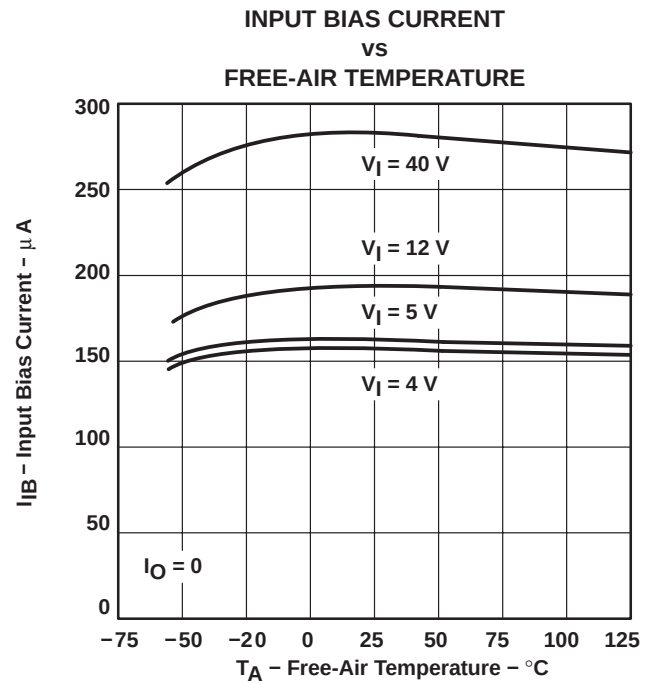
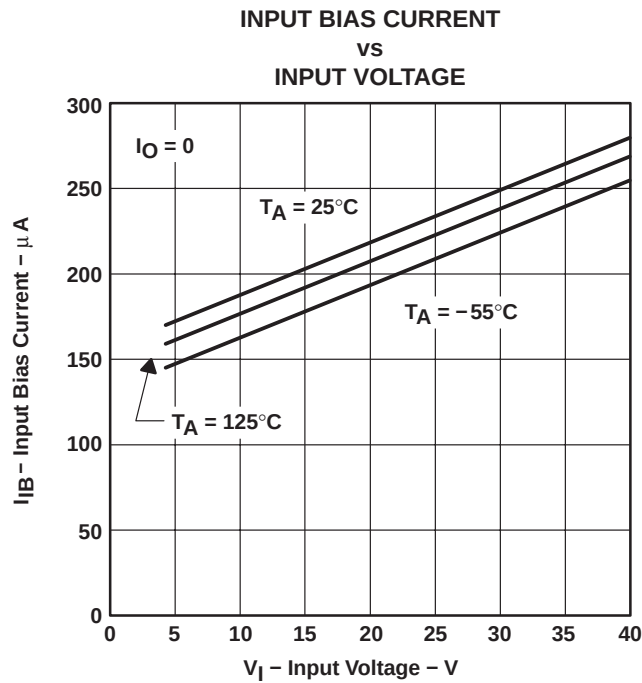


Figure 4

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

TYPICAL CHARACTERISTICS†



† 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

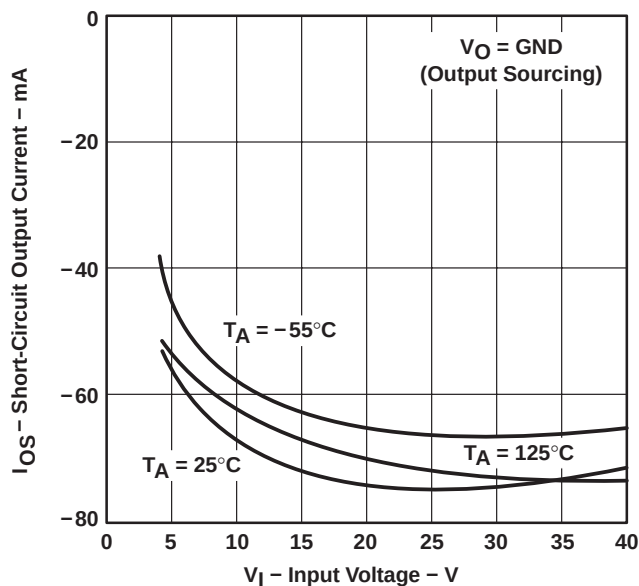


Figure 9

SHORT-CIRCUIT OUTPUT CURRENT
VS
INPUT VOLTAGE

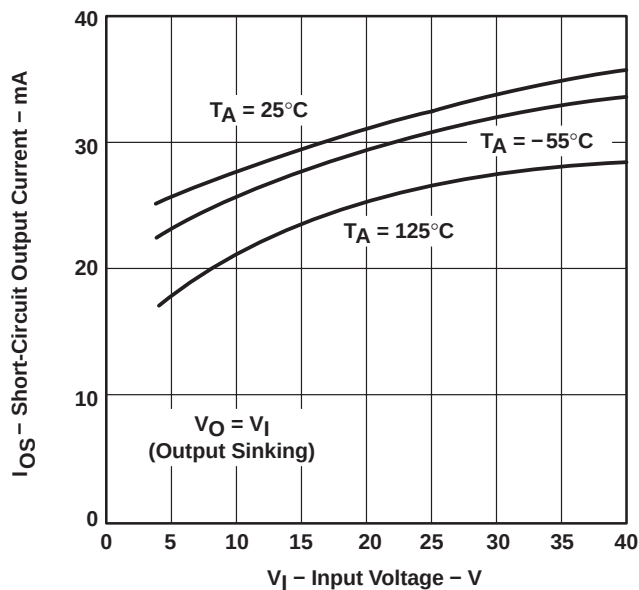


Figure 10

SHORT-CIRCUIT OUTPUT CURRENT
VS
FREE-AIR TEMPERATURE

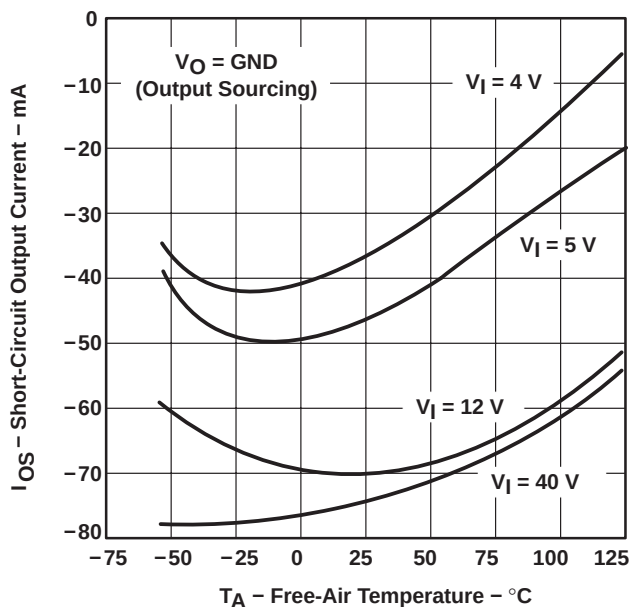


Figure 11

SHORT-CIRCUIT OUTPUT CURRENT
VS
FREE-AIR TEMPERATURE

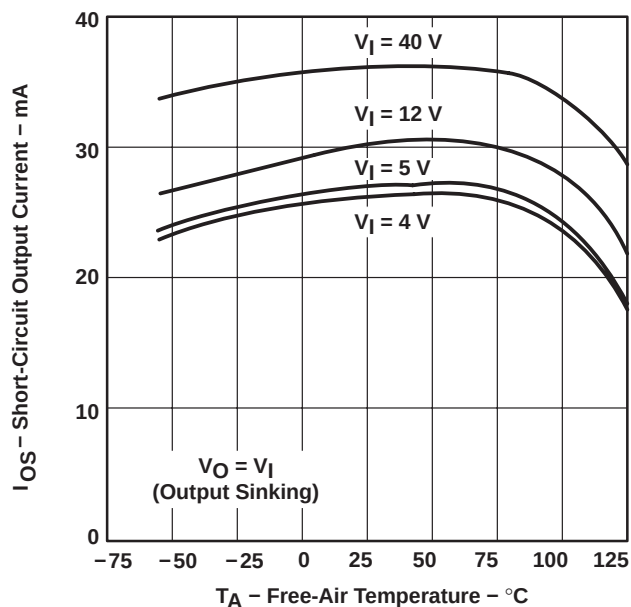
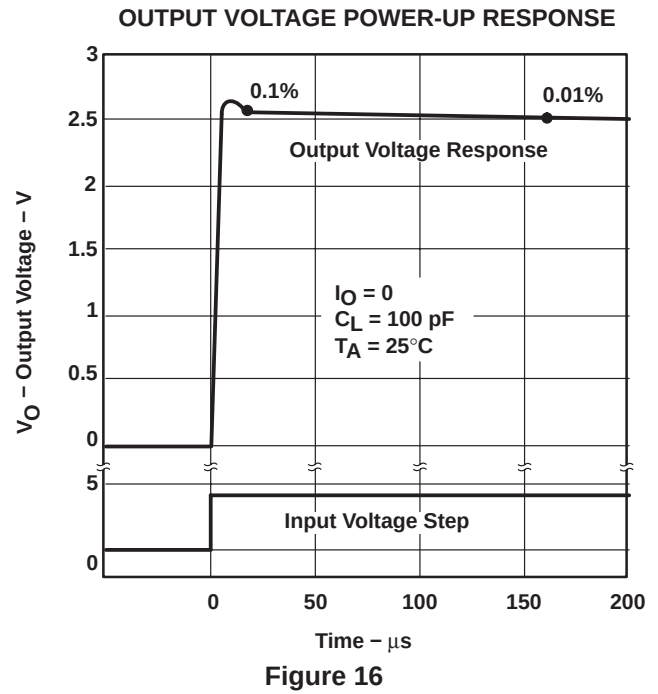
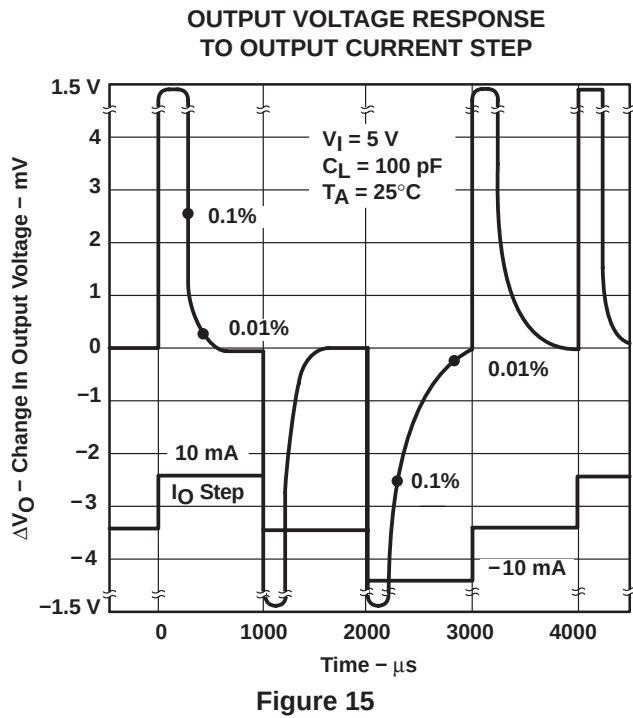
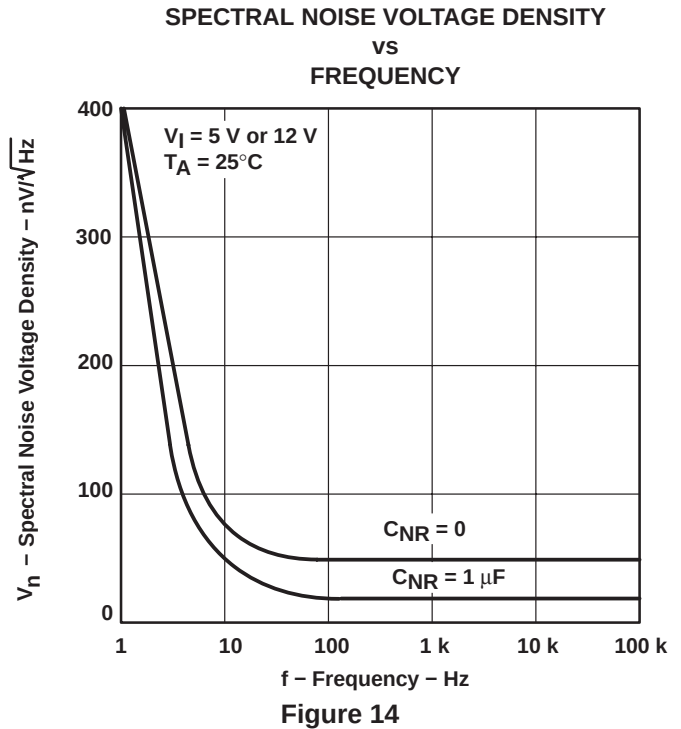
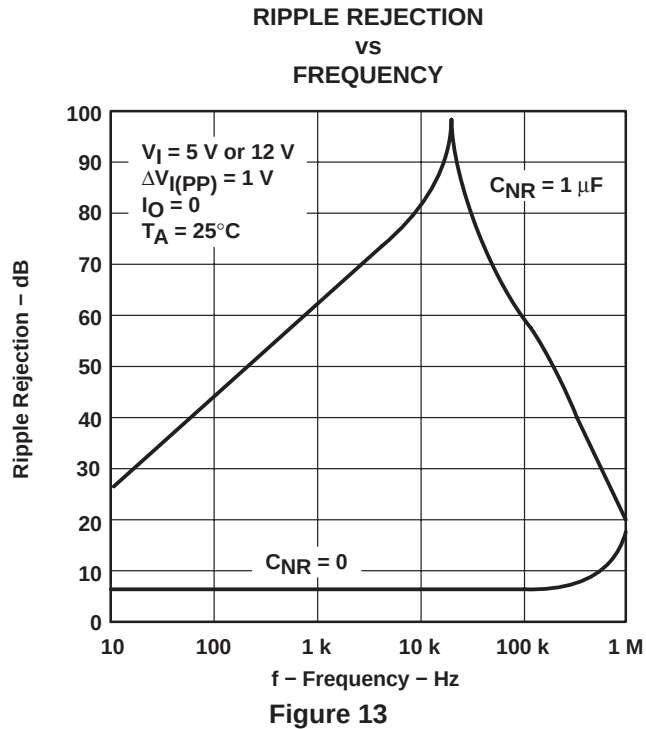


Figure 12

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

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

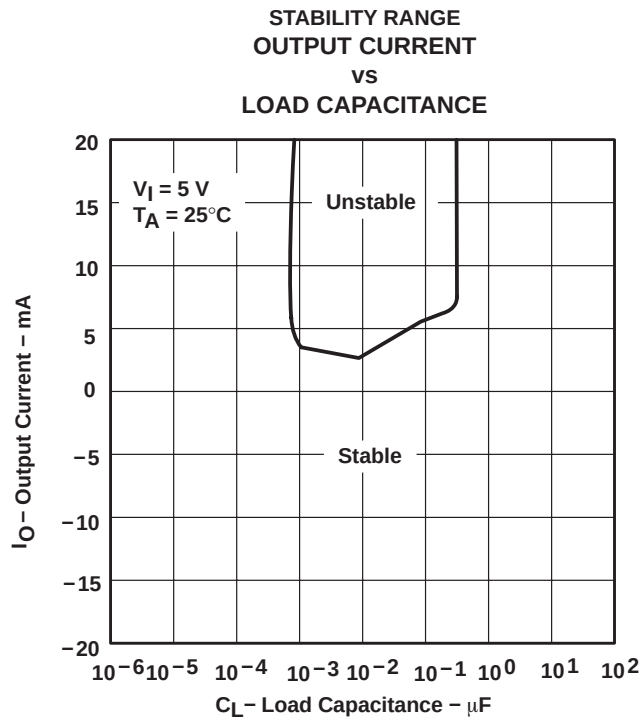


Figure 17

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
```

```

*      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 (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TLE2426QDRG4Q1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2426Q1	Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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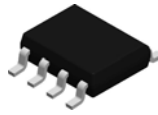
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TLE2426-Q1 :

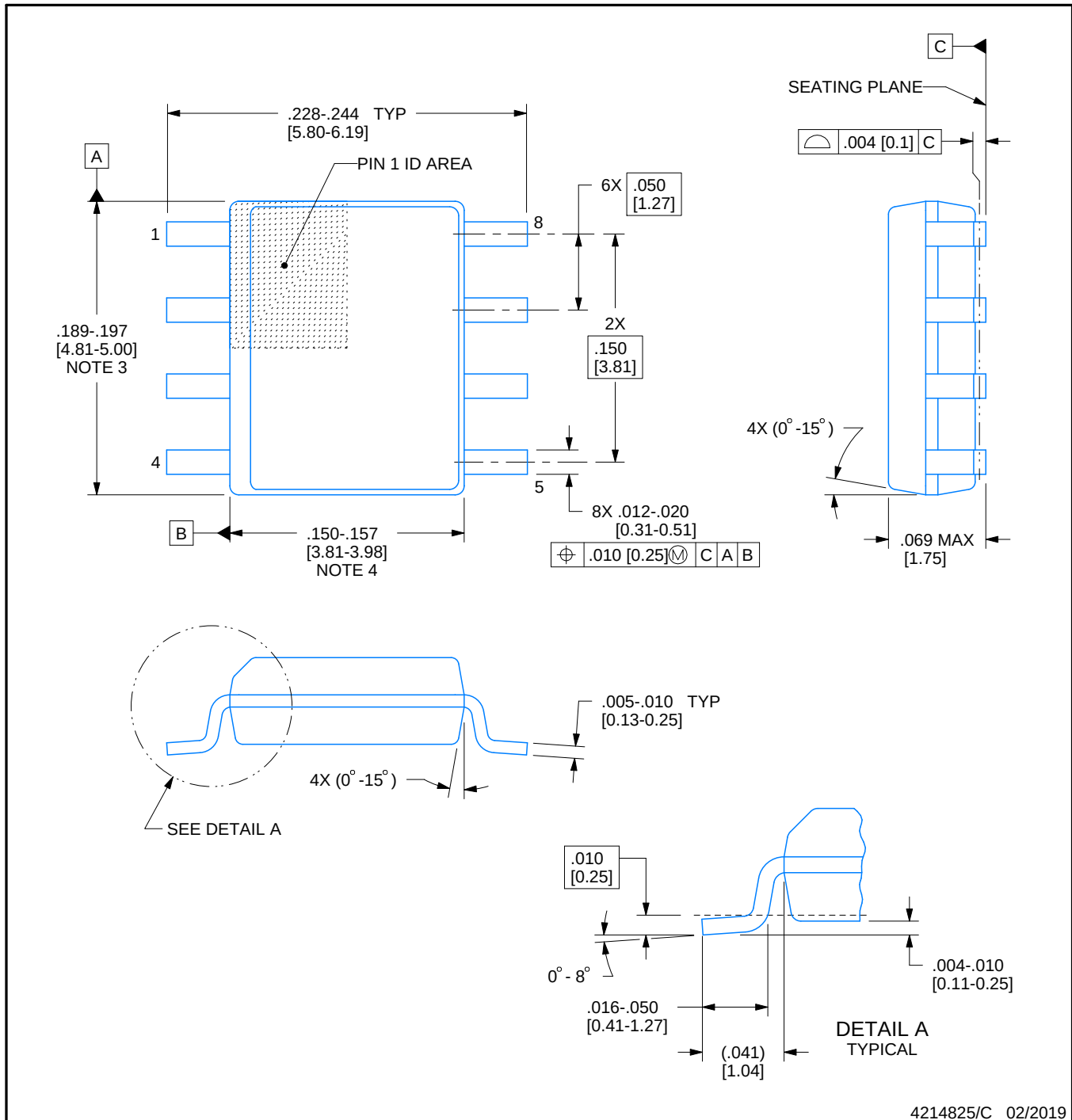
- Catalog: [TLE2426](#)
- Enhanced Product: [TLE2426-EP](#)

NOTE: Qualified Version Definitions:

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

D0008A**PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

NOTES:

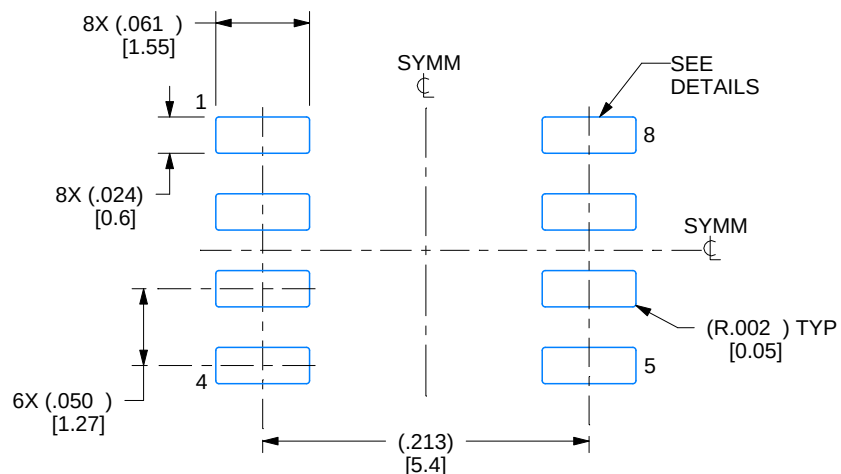
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

EXAMPLE BOARD LAYOUT

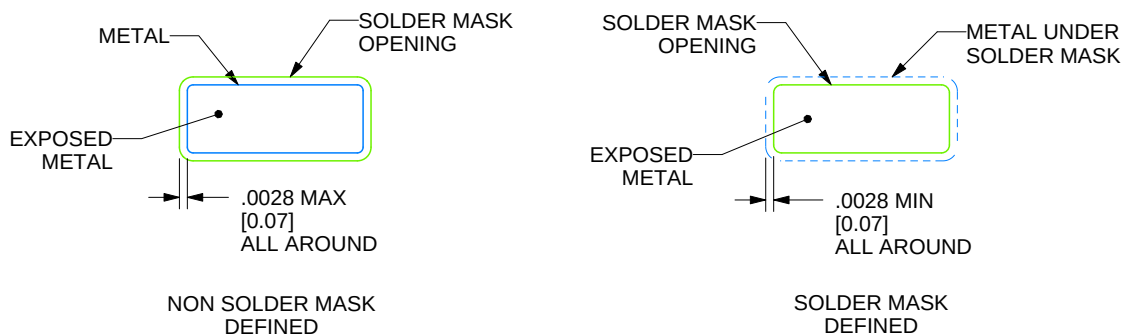
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

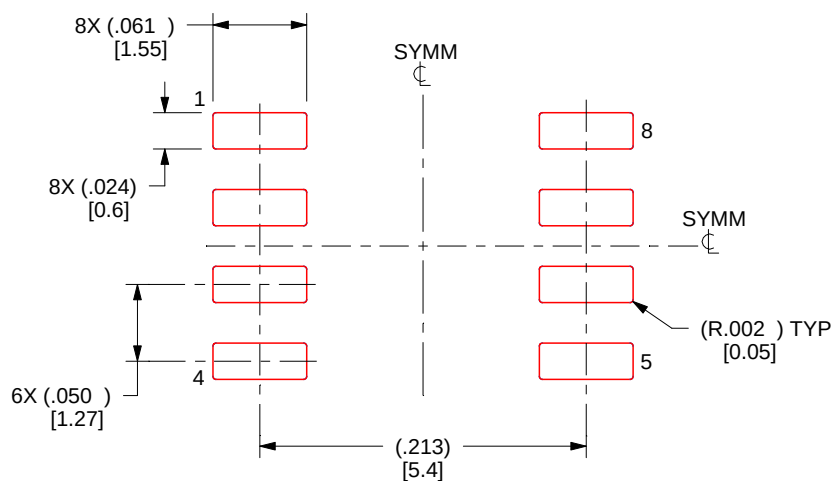
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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