

# TLV2422-Q1, TLV2422A-Q1

## Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT WIDE-INPUT-VOLTAGE MICROPOWER DUAL OPERATIONAL AMPLIFIERS

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- Qualified for Automotive Applications
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Output Swing Includes Both Supply Rails
- Extended Common-Mode Input Voltage Range . . . 0 V to 4.5 V (Min) With 5-V Single Supply
- No Phase Inversion
- Low Noise . . . 18 nV/√Hz Typ at f = 1 kHz
- Low Input Offset Voltage  
950 μV Max at T<sub>A</sub> = 25°C (TLV2422A)
- Low Input Bias Current . . . 1 pA Typ
- Micropower Operation . . . 50 μA Per Channel
- 600-Ω Output Drive

### description

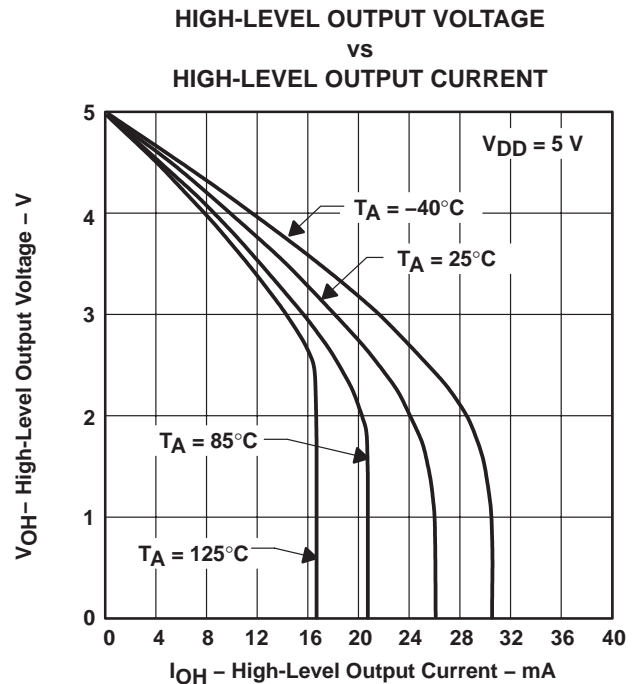
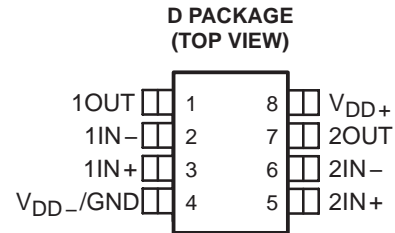
The TLV2422 and TLV2422A are dual low-voltage operational amplifiers from Texas Instruments. The common-mode input voltage range for this device has been extended over the typical CMOS amplifiers making them suitable for a wide range of applications. In addition, the devices do not phase invert when the common-mode input is driven to the supply rails. This satisfies most design requirements without paying a premium for rail-to-rail input performance. They also exhibit rail-to-rail output performance for increased dynamic range in single- or split-supply applications. This family is fully characterized at 3-V and 5-V supplies and is optimized for low-voltage operation.

The TLV2422 only requires 50 μA of supply current per channel, making it ideal for battery-powered applications. The TLV2422 also has increased output drive over previous rail-to-rail operational amplifiers and can drive 600-Ω loads for telecom applications.

Other members in the TLV2422 family are the high-power, TLV2442, and low-power, TLV2432, versions.

The TLV2422, exhibiting high input impedance and low noise, is excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the micropower dissipation levels and low-voltage operation, these devices work well in hand-held monitoring and remote-sensing applications. In addition, the rail-to-rail output feature with single- or split-supplies makes this family a great choice when interfacing with analog-to-digital converters (ADCs). For precision applications, the TLV2422A is available with a maximum input offset voltage of 950 μV.

If the design requires single operational amplifiers, see the TI TLV2211/21/31. This is a family of rail-to-rail output operational amplifiers in the SOT-23 package. Their small size and low power consumption, make them ideal for high density, battery-powered equipment.



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.

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**ORDERING INFORMATION†**

<b>T<sub>A</sub></b>	<b>V<sub>IO</sub>max AT 25°C</b>	<b>PACKAGE‡</b>		<b>ORDERABLE PART NUMBER</b>	<b>TOP-SIDE MARKING</b>
-40°C to 125°C	950 µV	SOIC (D)	Tape and reel	TLV2422AQDRQ1	2422AQ
	2.5 mV	SOIC (D)	Tape and reel	TLV2422QDRQ1	2422Q1

† 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>.

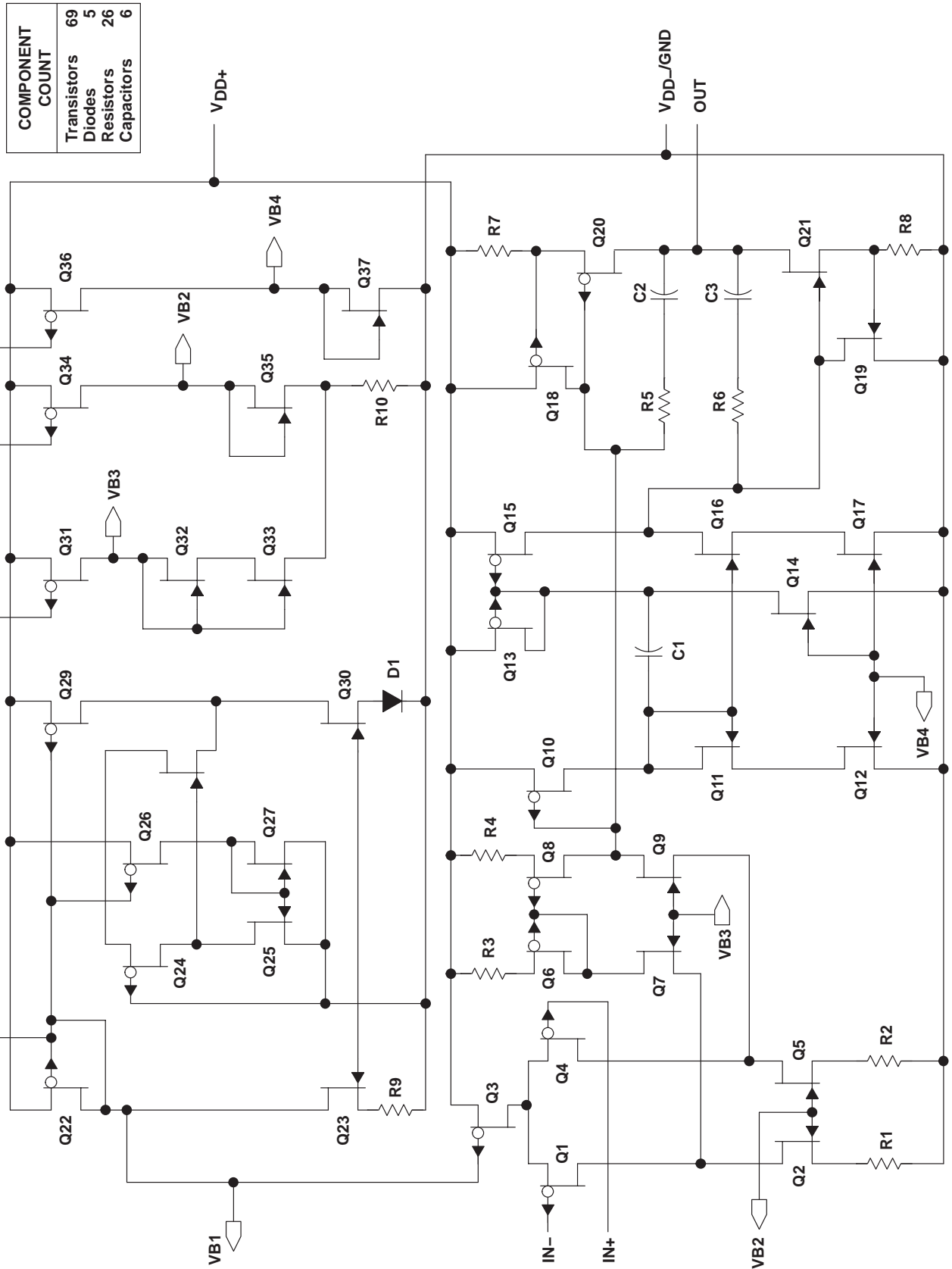


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equivalent schematic (each amplifier)



COMPONENT COUNT	
Transistors	69
Diodes	5
Resistors	26
Capacitors	6

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

Supply voltage, $V_{DD}$ (see Note 1)	12 V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm V_{DD}$
Input voltage, $V_I$ (any input, see Note 1): C and I suffix	-0.3 V to $V_{DD}$
Input current, $I_I$ (each input)	$\pm 5$ mA
Output current, $I_O$	$\pm 50$ mA
Total current into $V_{DD+}$	$\pm 50$ mA
Total current out of $V_{DD-}$	$\pm 50$ mA
Duration of short-circuit current at (or below) 25°C (see Note 3)	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	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.

- NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between  $V_{DD+}$  and  $V_{DD-}$ .  
 2. Differential voltages are at  $IN+$  with respect to  $IN-$ . Excessive current flows if input is brought below  $V_{DD-} - 0.3$  V.  
 3. 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	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW

**recommended operating conditions**

	MIN	MAX	UNIT
Supply voltage, $V_{DD\pm}$	2.7	10	V
Input voltage range, $V_I$	$V_{DD-}$	$V_{DD+} - 0.8$	V
Common-mode input voltage, $V_{IC}$	$V_{DD-}$	$V_{DD+} - 0.8$	V
Operating free-air temperature, $T_A$	-40	125	°C



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electrical characteristics at specified free-air temperature,  $V_{DD} = 3\text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV2422-Q1			TLV2422A-Q1			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage		25°C	300		2000	300		950	$\mu\text{V}$
		Full range	2500			1800			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2			2			$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0,$ $V_O = 0,$ $V_{DD} \pm \pm 1.5\text{ V},$ $R_S = 50\ \Omega$	25°C	0.003			0.003			$\mu\text{V}/\text{mo}$
$I_{IO}$ Input offset current		25°C	0.5		60	0.5		60	$\text{pA}$
		Full range	150			150			
$I_{IB}$ Input bias current		25°C	1		60	1		60	$\text{pA}$
		Full range	300			300			
$V_{ICR}$ Common-mode input voltage range	$ V_{IO}  \leq 5\text{ mV},$ $R_S = 50\ \Omega$	25°C	0 to 2.5	-0.25 to 2.75		0 to 2.5	-0.25 to 2.75		$\text{V}$
		Full range	0 to 2.2			0 to 2.2			
$V_{OH}$ High-level output voltage	$I_{OH} = -100\ \mu\text{A}$  $I_{OH} = -500\ \mu\text{A}$	25°C	2.97			2.97			$\text{V}$
		25°C	2.75			2.75			
		Full range	2.5			2.5			
$V_{OL}$ Low-level output voltage	$V_{IC} = 0,$ $I_{OL} = 100\ \mu\text{A}$  $V_{IC} = 0,$ $I_{OL} = 250\ \mu\text{A}$	25°C	0.05			0.05			$\text{V}$
		25°C	0.2			0.2			
		Full range	0.5			0.5			
$A_{VD}$ Large-signal differential voltage amplification	$V_{IC} = 1.5\text{ V},$ $V_O = 1\text{ V to }2\text{ V}$	25°C	$R_L = 10\ \text{k}\Omega$ ‡		6	10	6	10	$\text{V}/\text{mV}$
			$R_L = 1\ \text{M}\Omega$ ‡		700		700		
		Full range	2			2			
$r_{i(d)}$ Differential input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$r_{i(c)}$ Common-mode input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$c_{i(c)}$ Common-mode input capacitance	$f = 10\ \text{kHz}$	25°C	8			8			$\text{pF}$
$z_o$ Closed-loop output impedance	$f = 100\ \text{kHz},$ $A_V = 10$	25°C	130			130			$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR}\ \text{min},$ $V_O = 1.5\text{ V},$ $R_S = 50\ \Omega$	25°C	70	83		70	83		$\text{dB}$
		Full range	70			70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 2.7\text{ V to }8\text{ V},$ $V_{IC} = V_{DD}/2,$ No load	25°C	80	95		80	95		$\text{dB}$
		Full range	80			80			
$I_{DD}$ Supply current	$V_O = 1.5\text{ V},$ No load	25°C	100		150	100		150	$\mu\text{A}$
		Full range	175			175			

† Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part.

‡ Referenced to 1.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at  $T_A = 150^\circ\text{C}$  extrapolated to  $T_A = 25^\circ\text{C}$  using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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operating characteristics at specified free-air temperature,  $V_{DD} = 3\text{ V}$

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV2422-Q1, TLV2422A-Q1			UNIT
			MIN	TYP	MAX	
SR Slew rate at unity gain	$V_O = 1.1\text{ V to }1.9\text{ V},$ $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	0.01	0.02	V/ $\mu\text{s}$	
		Full range	0.008			
$V_n$ Equivalent input noise voltage	$f = 10\text{ Hz}$	25°C	100		nV/ $\sqrt{\text{Hz}}$	
	$f = 1\text{ kHz}$	25°C	23			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$	25°C	2.7		$\mu\text{V}$	
	$f = 0.1\text{ Hz to }10\text{ Hz}$	25°C	4			
$I_n$ Equivalent input noise current		25°C	0.6		fA/ $\sqrt{\text{Hz}}$	
THD + N Total harmonic distortion plus noise	$V_O = 0.5\text{ V to }2.5\text{ V},$ $f = 1\text{ kHz},$ $R_L = 10\text{ k}\Omega$ ‡	$A_V = 1$	0.25%			
		$A_V = 10$	1.8%			
Gain-bandwidth product	$f = 10\text{ kHz},$ $C_L = 100\text{ pF}$ ‡	$R_L = 10\text{ k}\Omega$ ‡, 25°C	46		kHz	
BOM Maximum output-swing bandwidth	$V_{O(PP)} = 1\text{ V},$ $R_L = 10\text{ k}\Omega$ ‡	$A_V = 1,$ $C_L = 100\text{ pF}$ ‡	25°C	8.3		kHz
$t_s$ Settling time	$A_V = -1,$ Step = 0.5 V to 2.5 V, $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	To 0.1%	25°C	8.6		$\mu\text{s}$
		To 0.01%		16		
$\phi_m$ Phase margin at unity gain	$R_L = 10\text{ k}\Omega$ ‡	$C_L = 100\text{ pF}$ ‡	25°C	62°		
Gain margin			25°C	11		

† Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part.

‡ Referenced to 1.5 V



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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV2422-Q1			TLV2422A-Q1			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage		25°C	300		2000	300		950	$\mu\text{V}$	
		Full range	2500			1800				
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2			2			$\mu\text{V}/^\circ\text{C}$	
Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0,$ $V_O = 0,$ $V_{DD} \pm \pm 2.5\text{ V},$ $R_S = 50\ \Omega$	25°C	0.003			0.003			$\mu\text{V}/\text{mo}$	
$I_{IO}$ Input offset current		25°C	0.5		60	0.5		60	$\text{pA}$	
		Full range	150			150				
$I_{IB}$ Input bias current		25°C	1		60	1		60	$\text{pA}$	
		Full range	300			300				
$V_{ICR}$ Common-mode input voltage range	$ V_{IO}  \leq 5\text{ mV},$ $R_S = 50\ \Omega$	25°C	0 to 4.5	-0.25 to 4.75		0 to 4.5	-0.25 to 4.75		$\text{V}$	
		Full range	0 to 4.2			0 to 4.2				
$V_{OH}$ High-level output voltage	$I_{OH} = -100\ \mu\text{A}$	25°C	4.97			4.97			$\text{V}$	
	$I_{OH} = -1\text{ mA}$	25°C	4.75			4.75				
	Full range	4.5			4.5					
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\text{ V},$ $I_{OL} = 100\ \mu\text{A}$	25°C	0.04			0.04			$\text{V}$	
	$V_{IC} = 2.5\text{ V},$ $I_{OL} = 500\ \mu\text{A}$	25°C	0.15			0.15				
	Full range	0.5			0.5					
$A_{VD}$ Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V},$ $V_O = 1\text{ V to }4\text{ V}$	$R_L = 10\text{ k}\Omega$ ‡	25°C	8	12	8	12	$\text{V}/\text{mV}$		
		$R_L = 1\text{ M}\Omega$ ‡	25°C	1000			1000			
		Full range	3			3				
$r_{i(d)}$ Differential input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$	
$r_{i(c)}$ Common-mode input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_{i(c)}$ Common-mode input capacitance	$f = 10\text{ kHz}$	25°C	8			8			$\text{pF}$	
$z_o$ Closed-loop output impedance	$f = 100\text{ kHz},$ $A_V = 10$	25°C	130			130			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR}\text{ min},$ $V_O = 2.5\text{ V},$ $R_S = 50\ \Omega$	25°C	70	90		70	90	$\text{dB}$		
		Full range	70			70				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }8\text{ V},$ $V_{IC} = V_{DD}/2,$ No load	25°C	80	95		80	95	$\text{dB}$		
		Full range	80			80				
$I_{DD}$ Supply current	$V_O = 2.5\text{ V},$ No load	25°C	100		150	100		150	$\mu\text{A}$	
		Full range	175			175				

† Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part.

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at  $T_A = 150^\circ\text{C}$  extrapolated to  $T_A = 25^\circ\text{C}$  using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$

PARAMETER	TEST CONDITIONS	$T_A$ †	TLV2422-Q1, TLV2422A-Q1			UNIT
			MIN	TYP	MAX	
SR Slew rate at unity gain	$V_O = 1.5\text{ V to }3.5\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C	0.01	0.02	V/ $\mu$ s	
		Full range	0.008			
$V_n$ Equivalent input noise voltage	$f = 10\text{ Hz}$	25°C	100		nV/ $\sqrt{\text{Hz}}$	
	$f = 1\text{ kHz}$	25°C	18			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$	25°C	1.9		$\mu$ V	
	$f = 0.1\text{ Hz to }10\text{ Hz}$	25°C	2.8			
$I_n$ Equivalent input noise current		25°C	0.6		fA/ $\sqrt{\text{Hz}}$	
THD + N Total harmonic distortion plus noise	$V_O = 1.5\text{ V to }3.5\text{ V}, f = 1\text{ kHz}, R_L = 10\text{ k}\Omega^\ddagger$	$A_V = 1$	0.24%			
		$A_V = 10$	1.7%			
Gain-bandwidth product	$f = 10\text{ kHz}, C_L = 100\text{ pF}^\ddagger, R_L = 10\text{ k}\Omega^\ddagger$	25°C	52		kHz	
BOM Maximum output-swing bandwidth	$V_{O(PP)} = 2\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, A_V = 1, C_L = 100\text{ pF}^\ddagger$	25°C	5.3		kHz	
$t_s$ Settling time	$A_V = -1, \text{ Step} = 1.5\text{ V to }3.5\text{ V}, R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	$T_o = 0.1\%$	8.5		$\mu$ s	
		$T_o = 0.01\%$	15.5			
$\phi_m$ Phase margin at unity gain	$R_L = 10\text{ k}\Omega^\ddagger, C_L = 100\text{ pF}^\ddagger$	25°C	66°			
Gain margin		25°C	11		dB	

† Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  for Q level part.

‡ Referenced to 2.5 V





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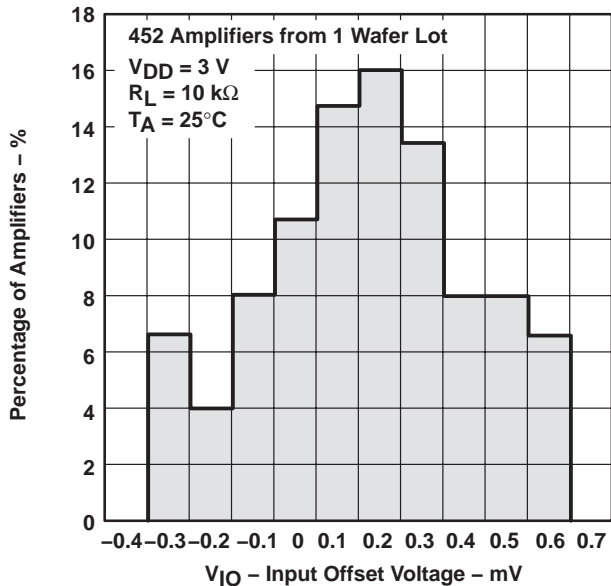
**TYPICAL CHARACTERISTICS**

**Table of Graphs**

			FIGURE
$V_{IO}$	Input offset voltage	Distribution vs Common-mode input voltage	2,3 4,5
$\alpha_{VIO}$	Input offset voltage temperature coefficient	Distribution	6,7
$I_{IB}/I_{IO}$	Input bias and input offset currents	vs Free-air temperature	8
$V_{OH}$	High-level output voltage	vs High-level output current	9,11
$V_{OL}$	Low-level output voltage	vs Low-level output current	10,12
$V_{O(PP)}$	Maximum peak-to-peak output voltage	vs Frequency	13
$I_{OS}$	Short-circuit output current	vs Supply voltage	14
		vs Free-air temperature	15
$V_{ID}$	Differential input voltage	vs Output voltage	16,17
		Differential gain	vs Load resistance
$A_{VD}$	Large-signal differential voltage amplification Differential voltage amplification	vs Frequency	19,20
		vs Free-air temperature	21,22
$z_o$	Output impedance	vs Frequency	23,24
CMRR	Common-mode rejection ratio	vs Frequency	25
		vs Free-air temperature	26
$k_{SVR}$	Supply-voltage rejection ratio	vs Frequency	27,28
		vs Free-air temperature	29
$I_{DD}$	Supply current	vs Supply voltage	30
SR	Slew rate	vs Load capacitance	31
		vs Free-air temperature	32
$V_O$	Inverting large-signal pulse response		33,34
$V_O$	Voltage-follower large-signal pulse response		35,36
$V_O$	Inverting small-signal pulse response		37,38
$V_O$	Voltage-follower small-signal pulse response		39,40
$V_n$	Equivalent input noise voltage	vs Frequency	41, 42
		Noise voltage (referred to input)	Over a 10-second period
THD + N	Total harmonic distortion plus noise	vs Frequency	44,45
		Gain-bandwidth product	vs Supply voltage vs Free-air temperature
$\phi_m$	Phase margin	vs Frequency	19,20
		vs Load capacitance	48
	Gain margin	vs Load capacitance	49
$B_1$	Unity-gain bandwidth	vs Load capacitance	50

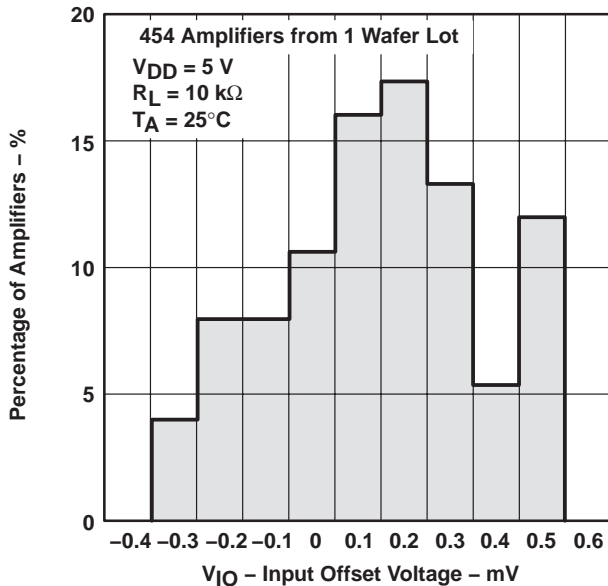
**TYPICAL CHARACTERISTICS**

**DISTRIBUTION OF TLV2422  
 INPUT OFFSET VOLTAGE**



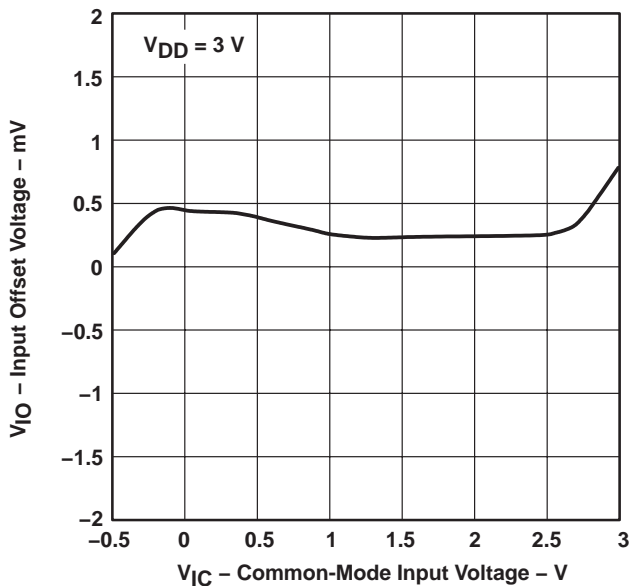
**Figure 2**

**DISTRIBUTION OF TLV2422  
 INPUT OFFSET VOLTAGE**



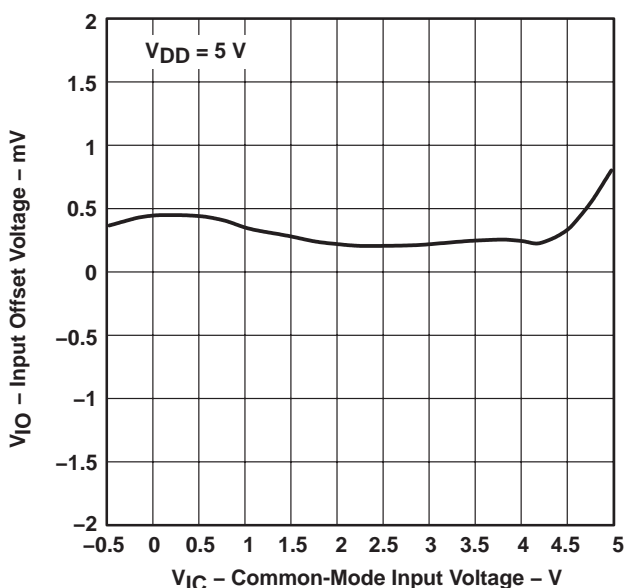
**Figure 3**

**INPUT OFFSET VOLTAGE  
 vs  
 COMMON-MODE INPUT VOLTAGE**



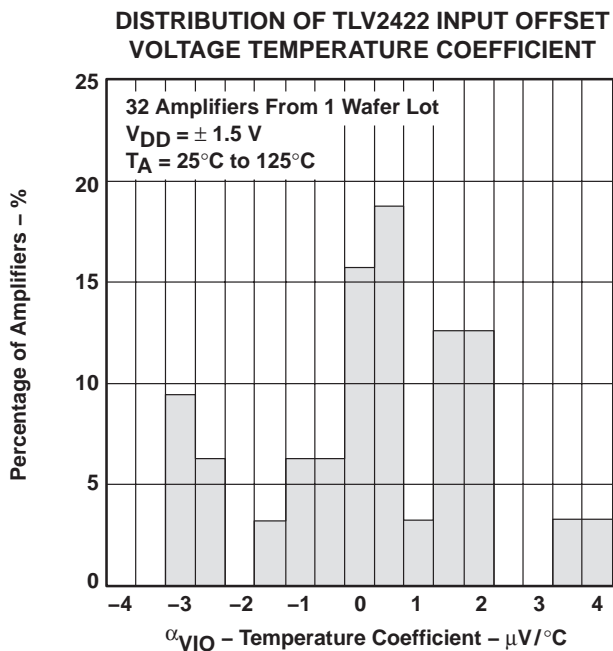
**Figure 4**

**INPUT OFFSET VOLTAGE  
 vs  
 COMMON-MODE INPUT VOLTAGE**

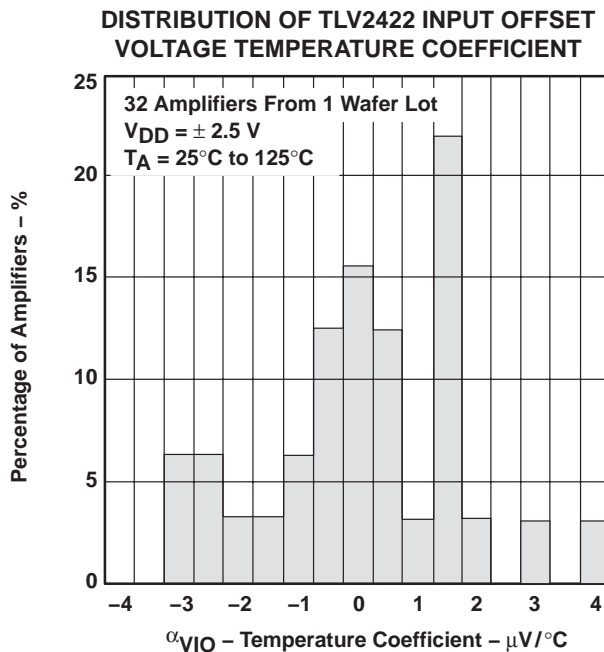


**Figure 5**

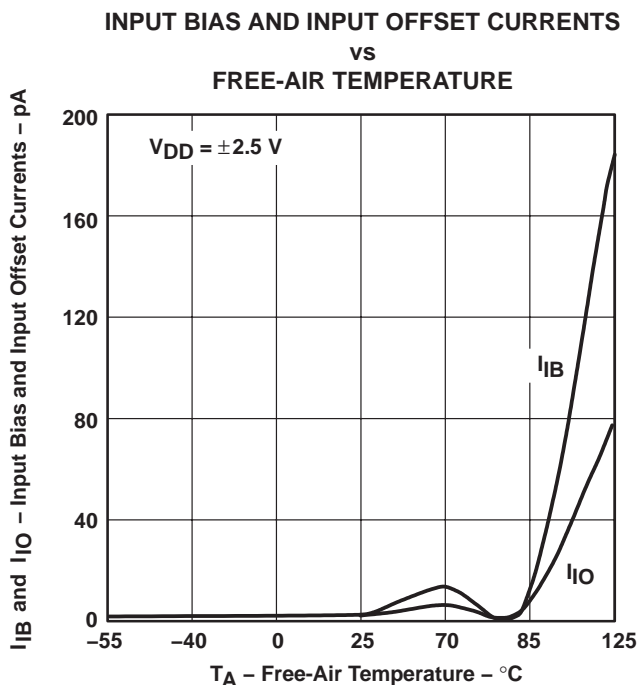
**TYPICAL CHARACTERISTICS**



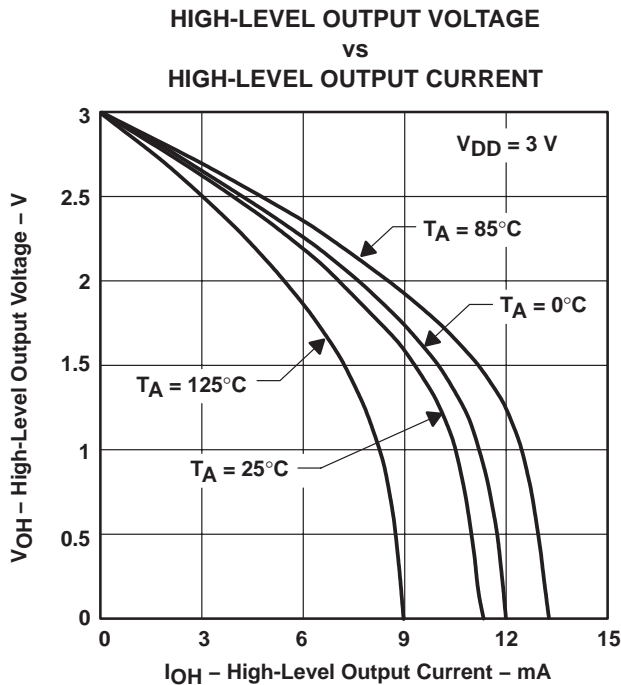
**Figure 6**



**Figure 7**

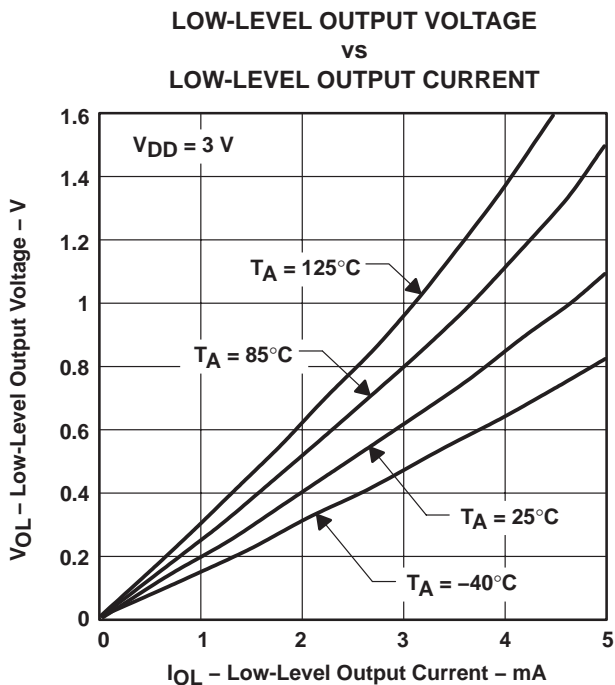


**Figure 8**

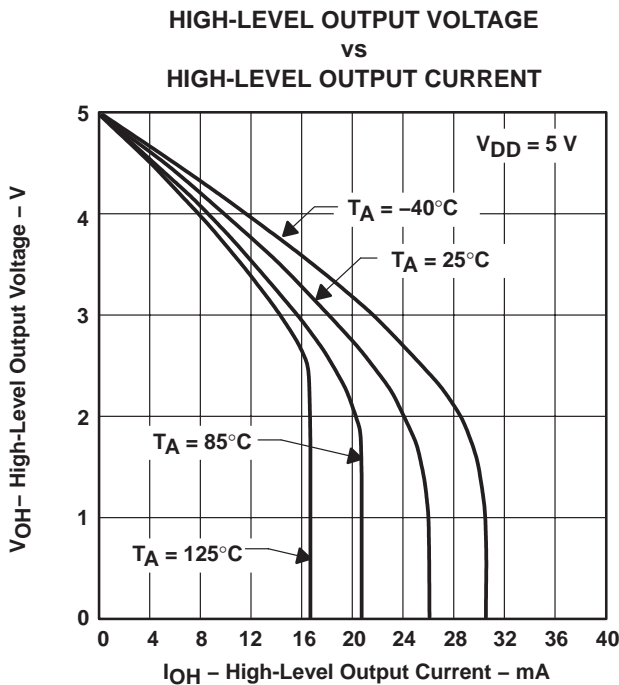


**Figure 9**

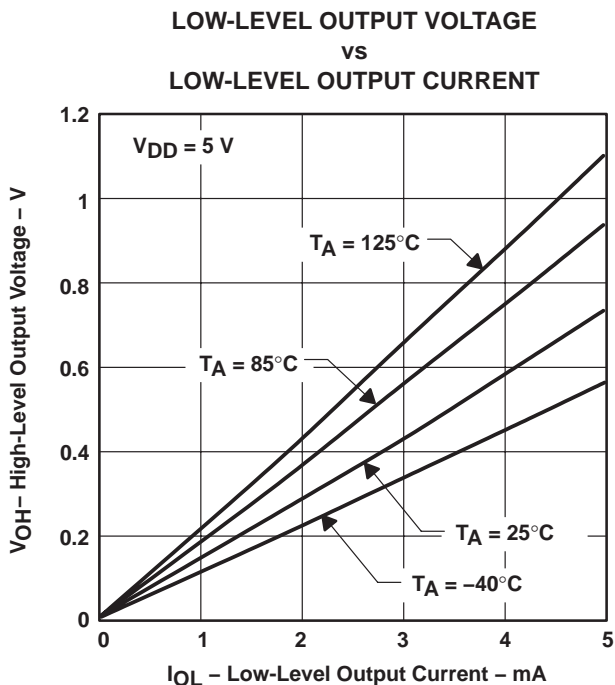
**TYPICAL CHARACTERISTICS**



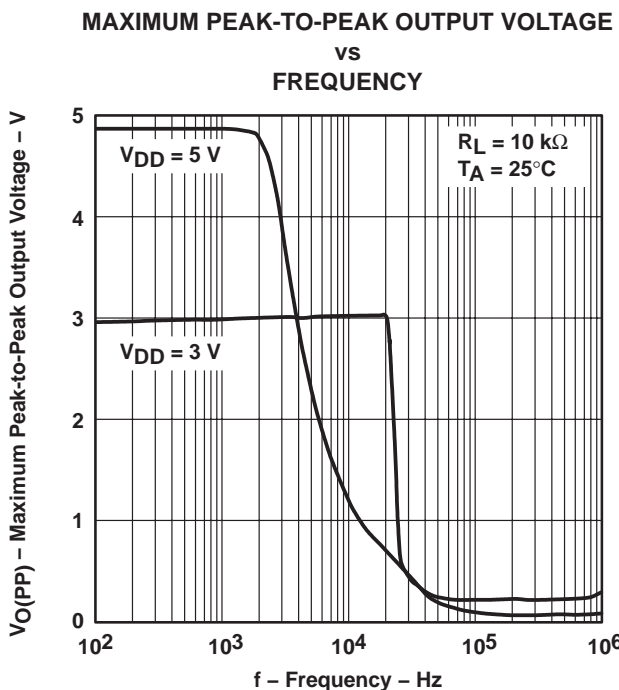
**Figure 10**



**Figure 11**



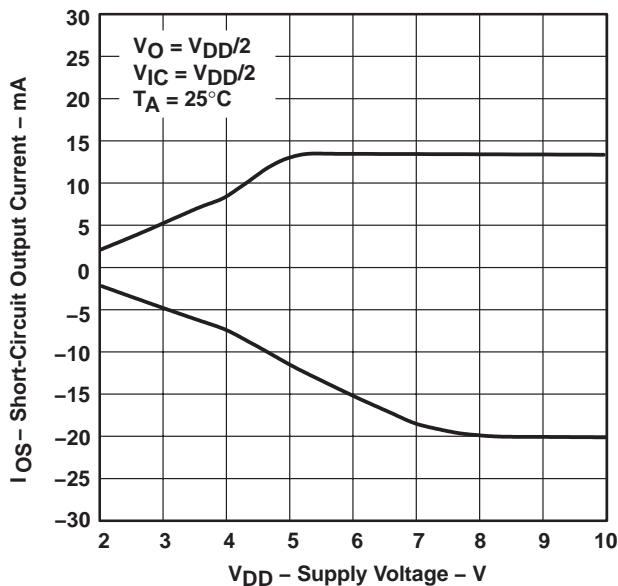
**Figure 12**



**Figure 13**

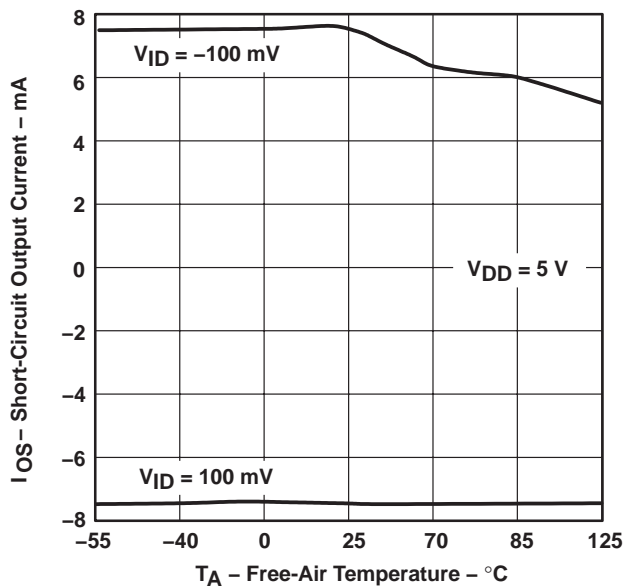
**TYPICAL CHARACTERISTICS**

**SHORT-CIRCUIT OUTPUT CURRENT  
vs  
SUPPLY VOLTAGE**



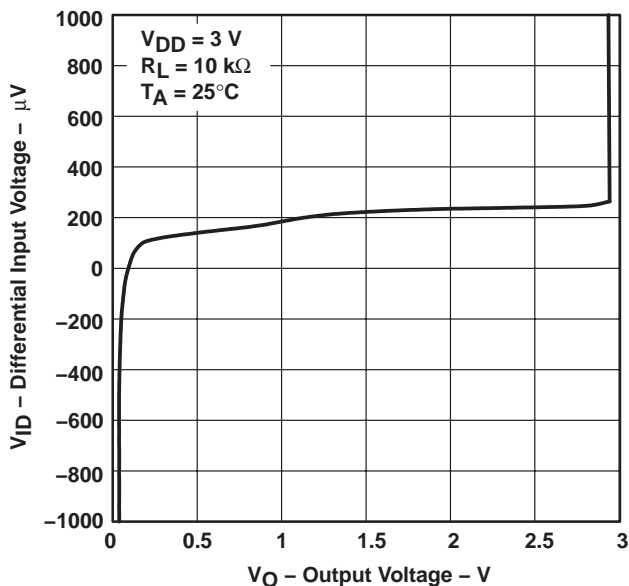
**Figure 14**

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



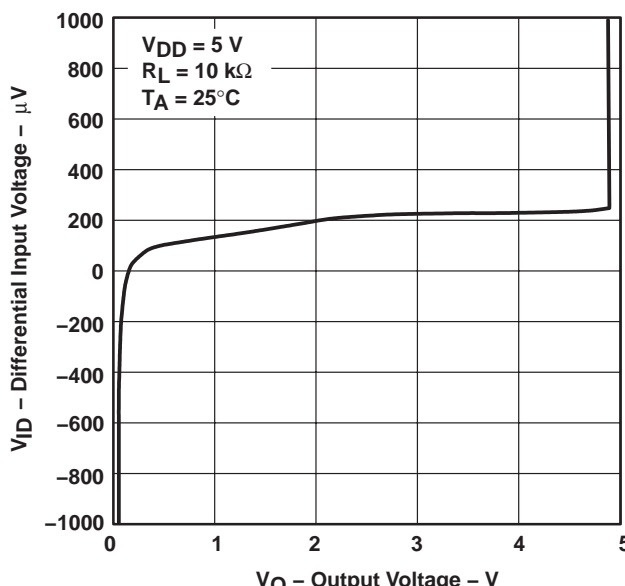
**Figure 15**

**DIFFERENTIAL INPUT VOLTAGE  
vs  
OUTPUT VOLTAGE**



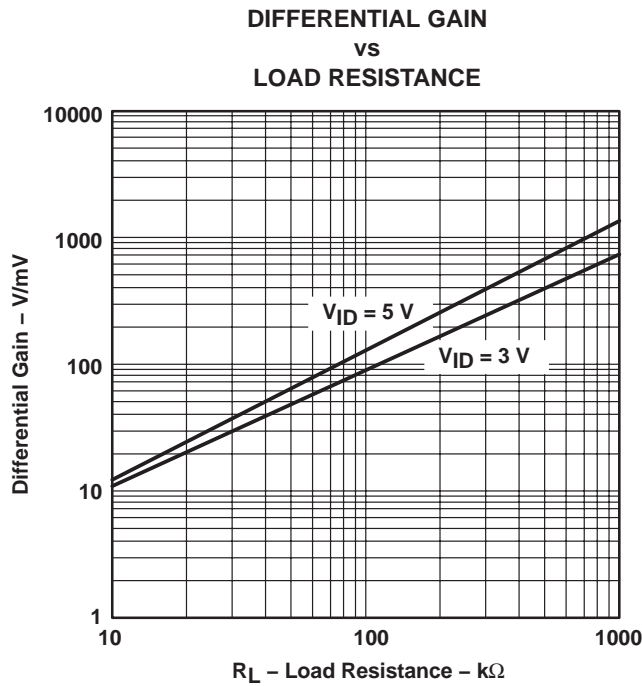
**Figure 16**

**DIFFERENTIAL INPUT VOLTAGE  
vs  
OUTPUT VOLTAGE**

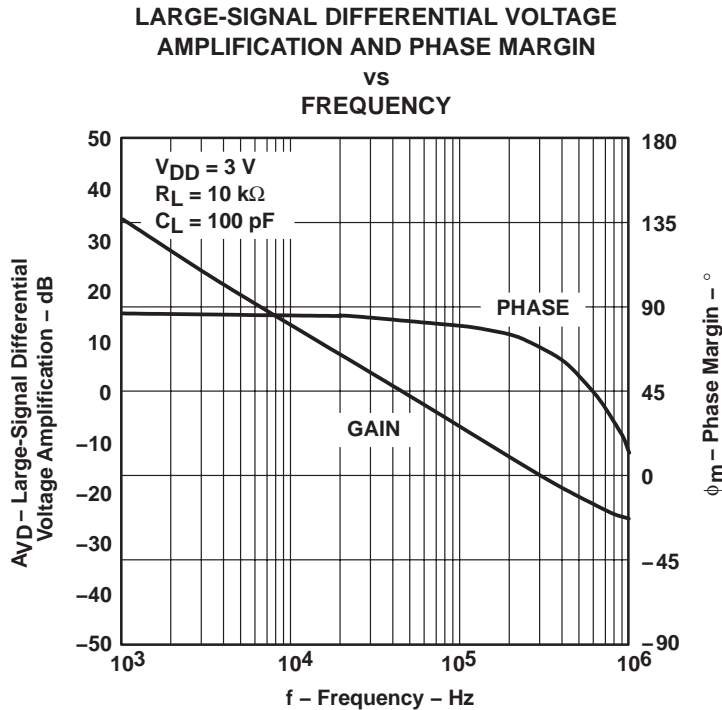


**Figure 17**

**TYPICAL CHARACTERISTICS**



**Figure 18**



**Figure 19**

**TYPICAL CHARACTERISTICS**

**LARGE-SIGNAL DIFFERENTIAL VOLTAGE  
AMPLIFICATION AND PHASE MARGIN**

vs  
**FREQUENCY**

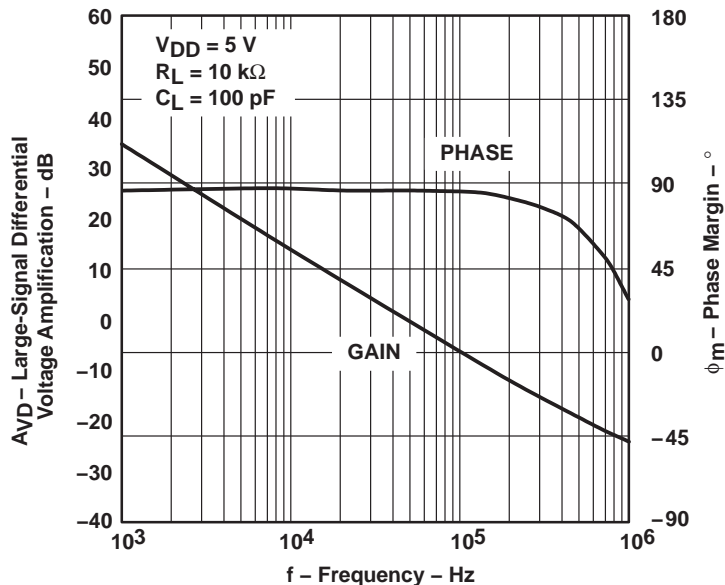


Figure 20

**DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREE-AIR TEMPERATURE**

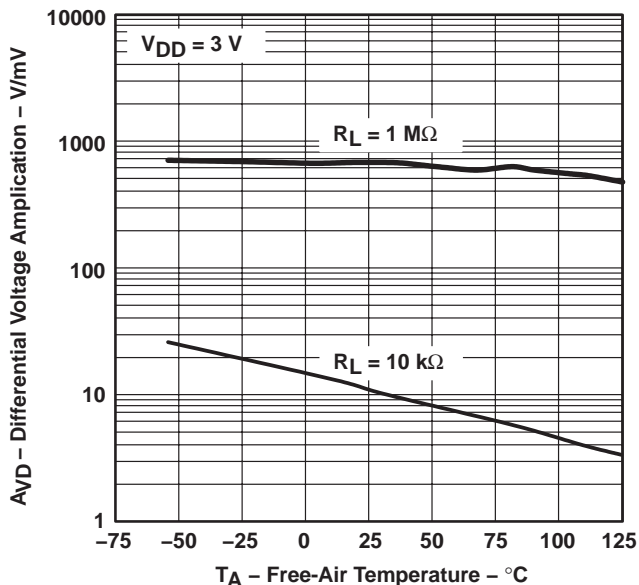


Figure 21

**DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREE-AIR TEMPERATURE**

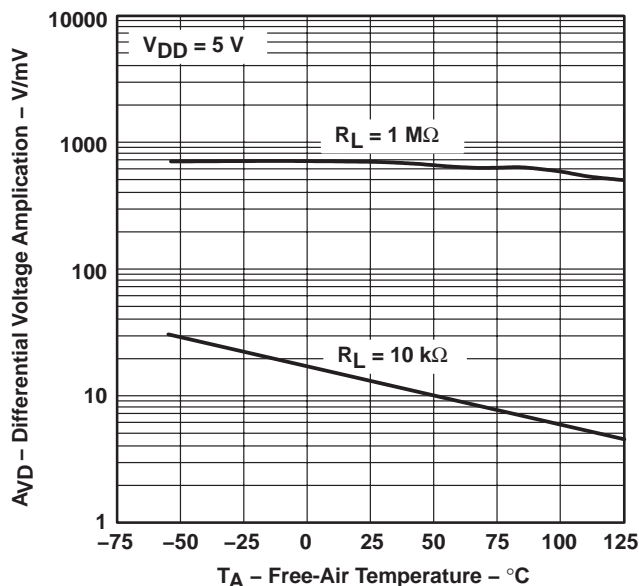
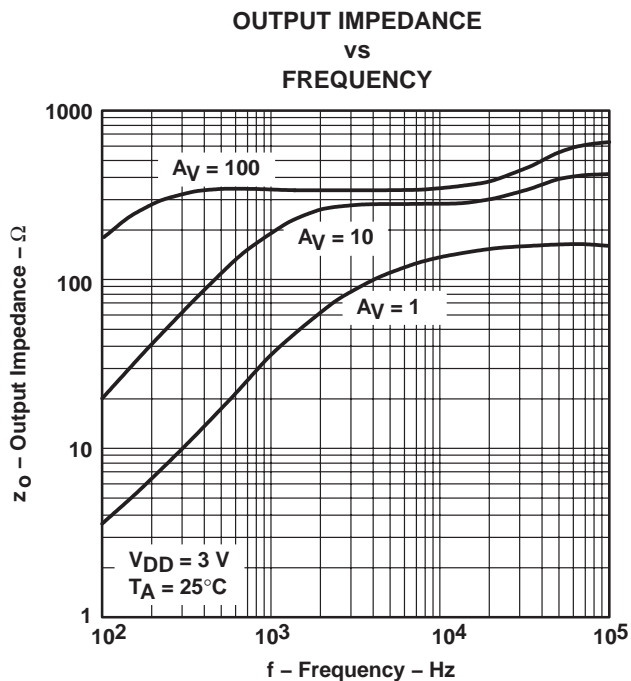
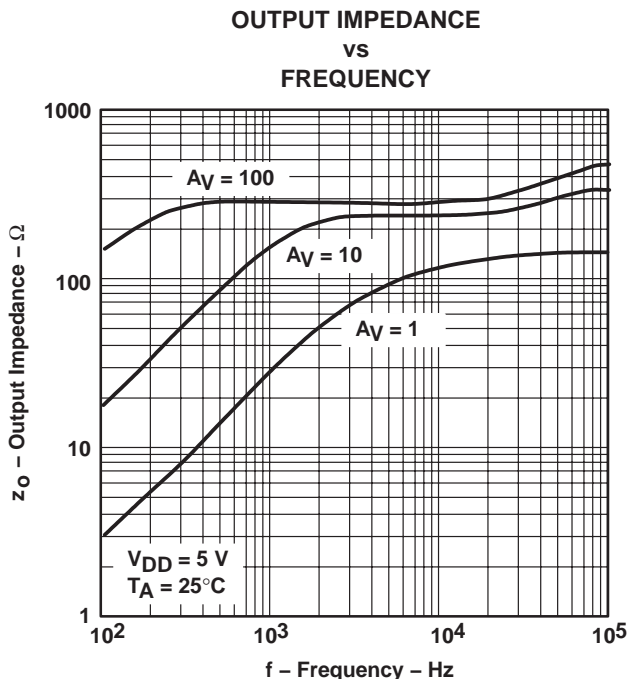


Figure 22

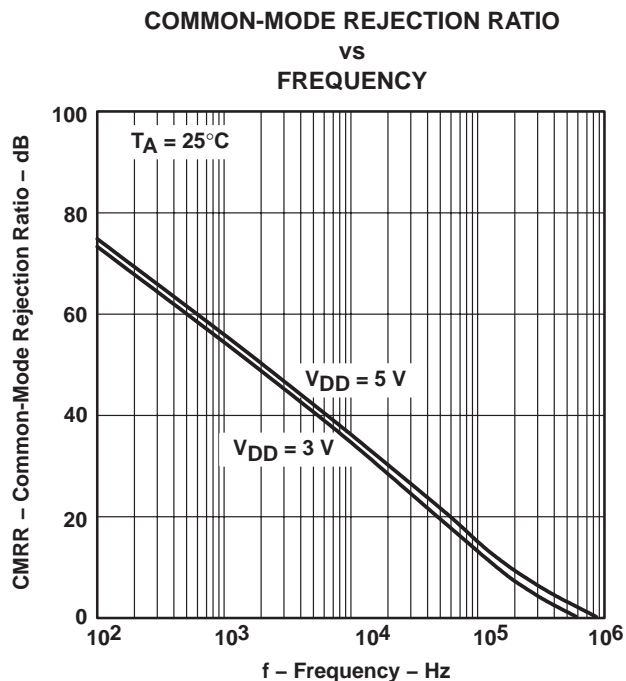
**TYPICAL CHARACTERISTICS**



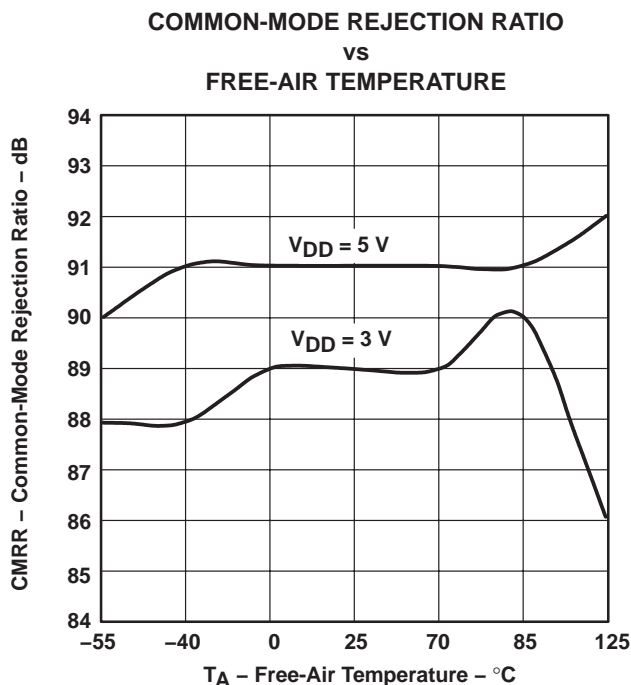
**Figure 23**



**Figure 24**



**Figure 25**



**Figure 26**



TYPICAL CHARACTERISTICS

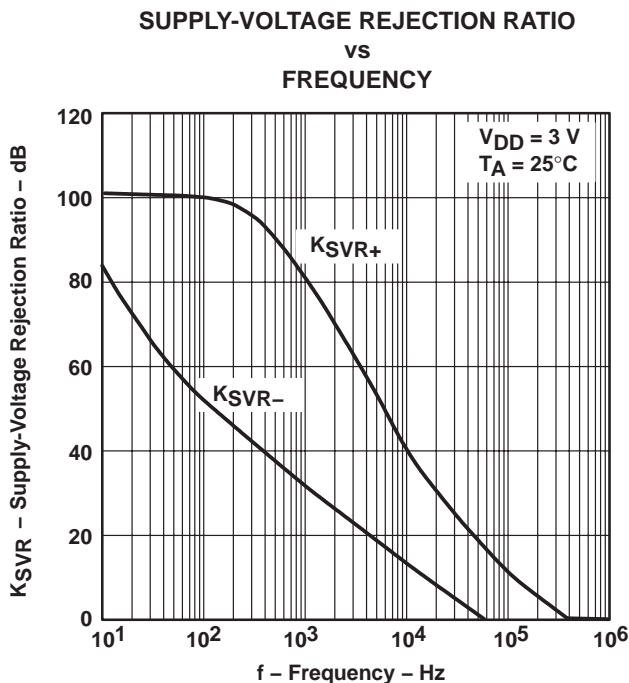


Figure 27

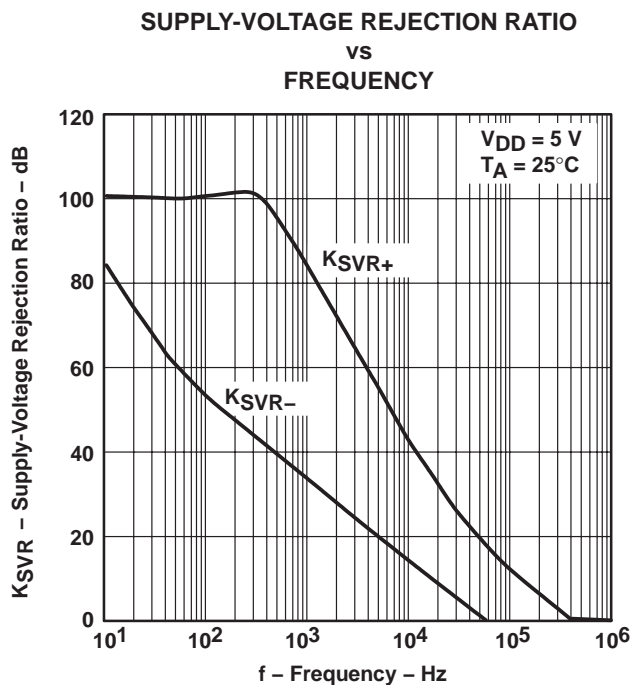


Figure 28

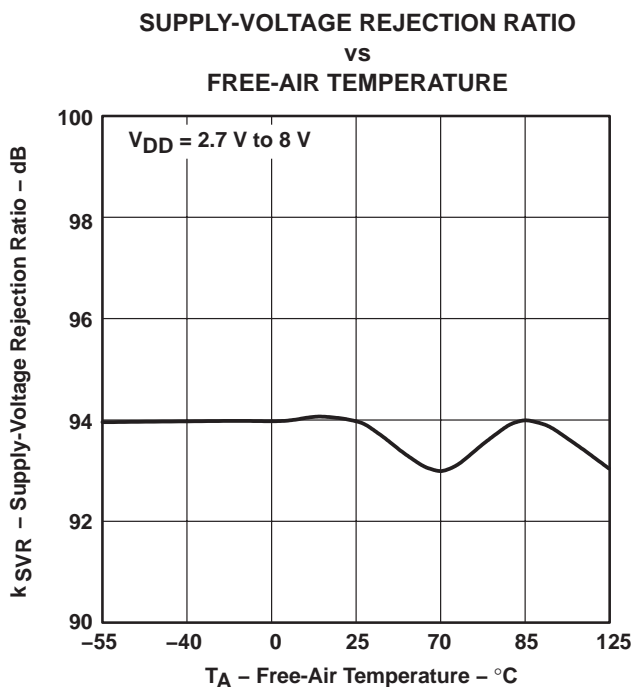


Figure 29

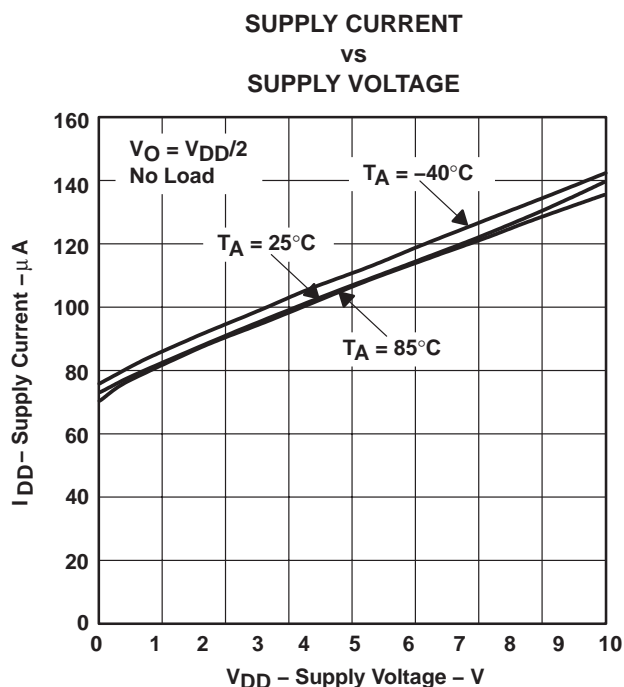
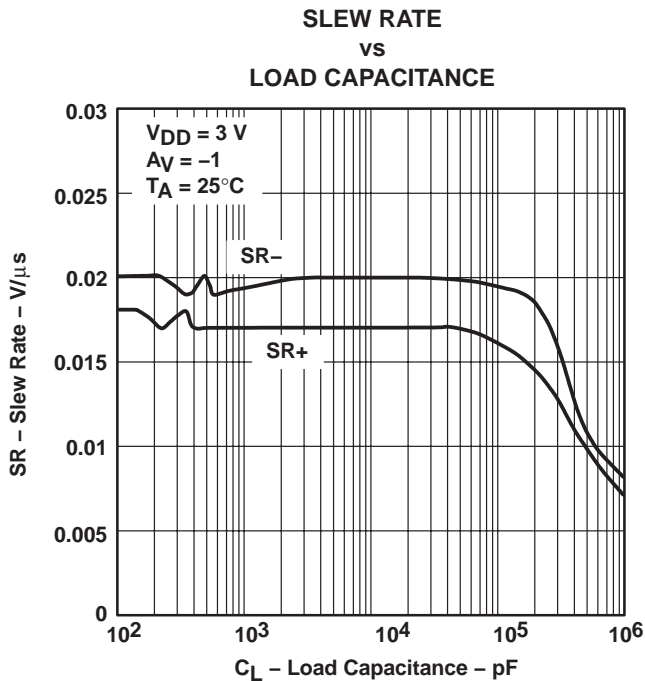
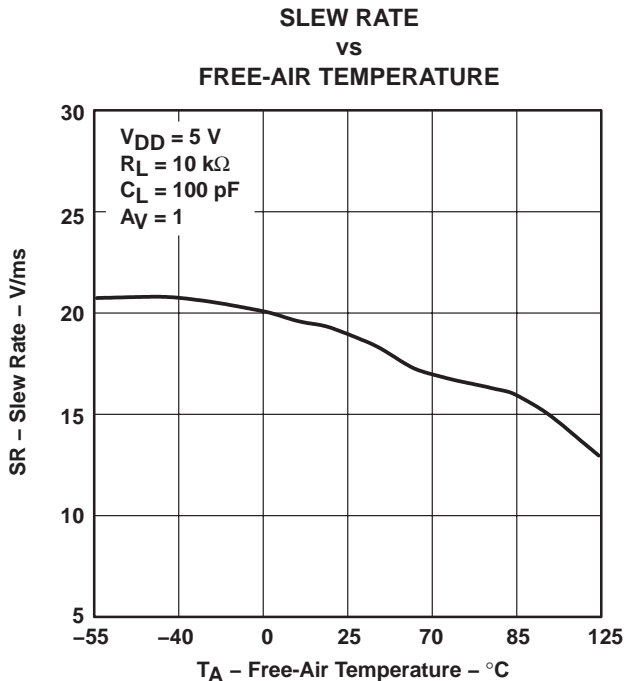


Figure 30

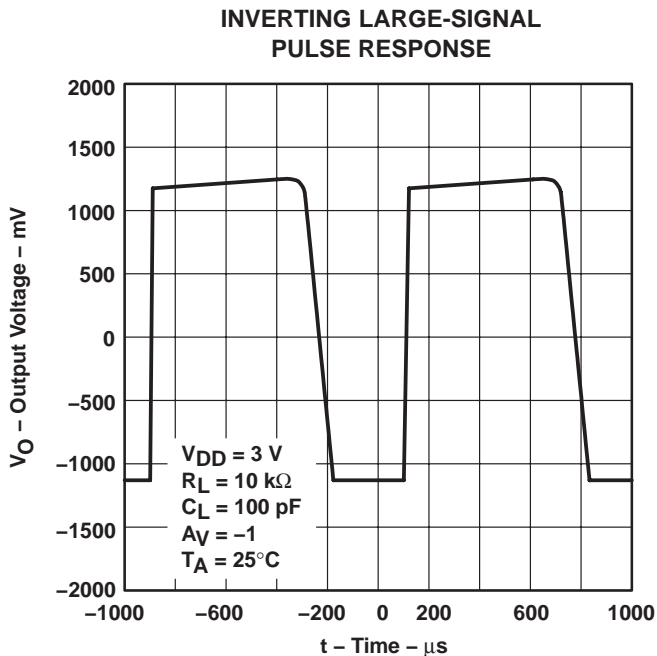
**TYPICAL CHARACTERISTICS**



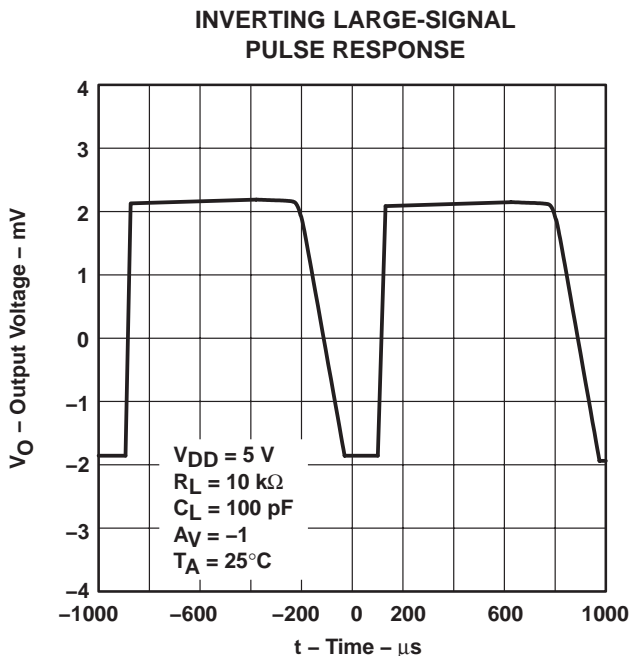
**Figure 31**



**Figure 32**



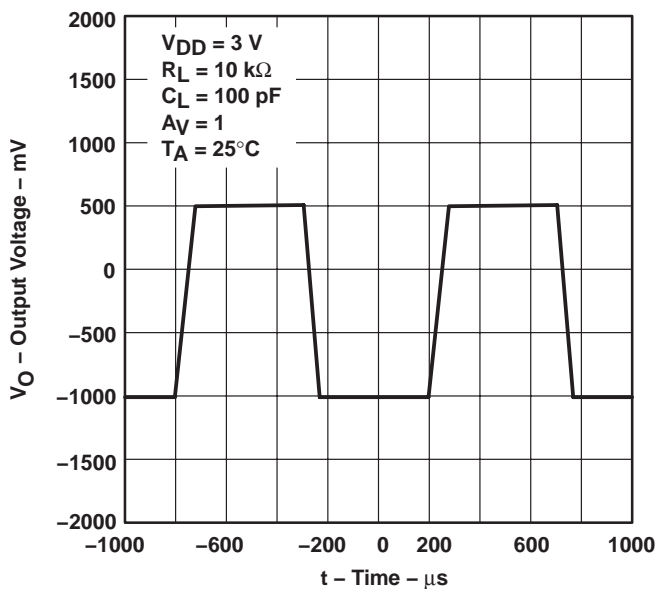
**Figure 33**



**Figure 34**

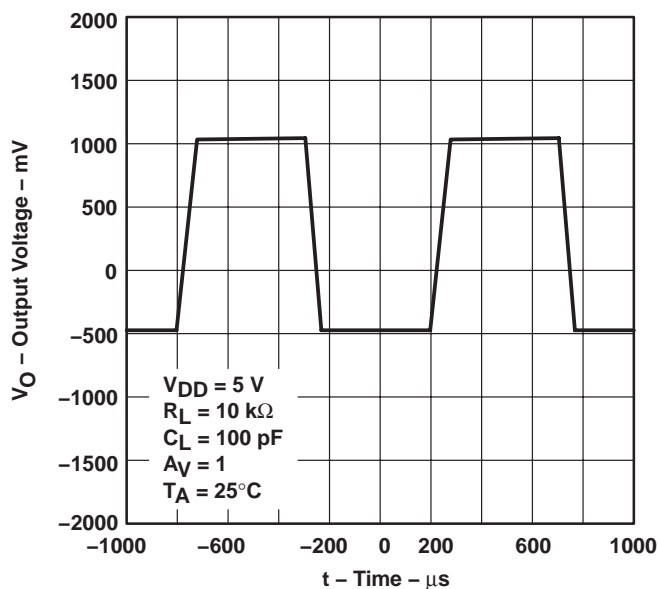
**TYPICAL CHARACTERISTICS**

**VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE**



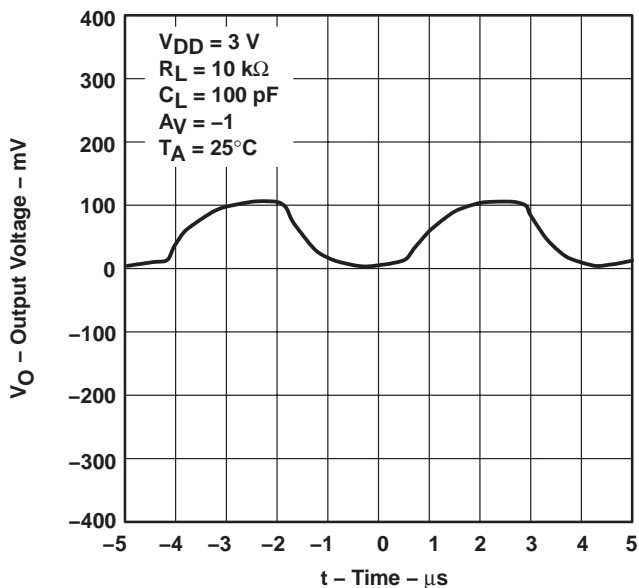
**Figure 35**

**VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE**



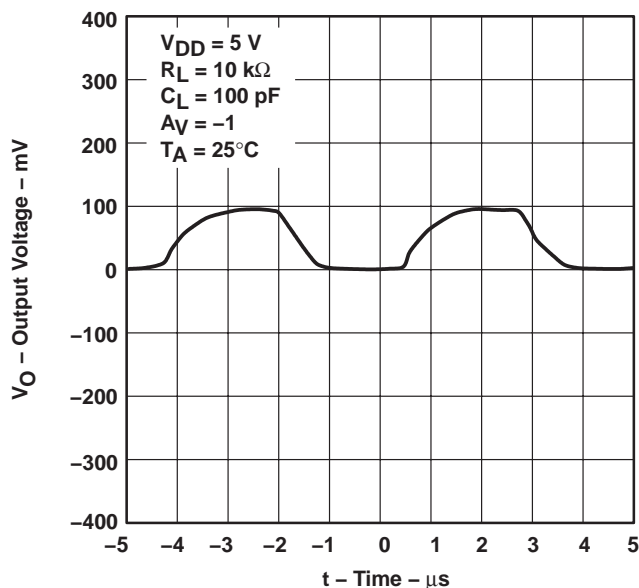
**Figure 36**

**INVERTING SMALL-SIGNAL PULSE RESPONSE**



**Figure 37**

**INVERTING SMALL-SIGNAL PULSE RESPONSE**



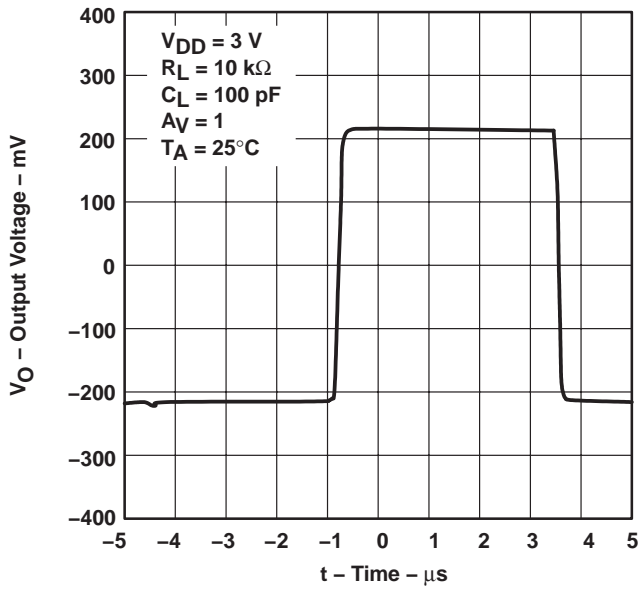
**Figure 38**

**TLV2422-Q1, TLV2422A-Q1**  
**Advanced LinCMOS™ RAIL-TO-RAIL OUTPUT**  
**WIDE-INPUT-VOLTAGE MICROPOWER DUAL OPERATIONAL AMPLIFIERS**

SGLS175 – AUGUST 2003

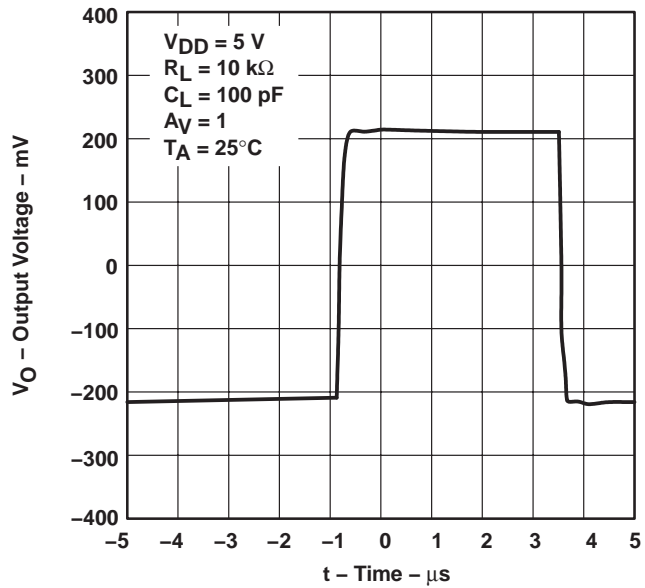
**TYPICAL CHARACTERISTICS**

**VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE**



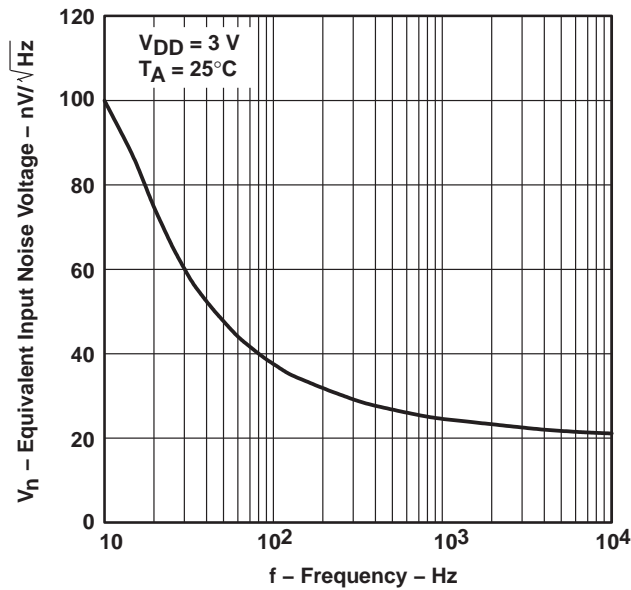
**Figure 39**

**VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE**



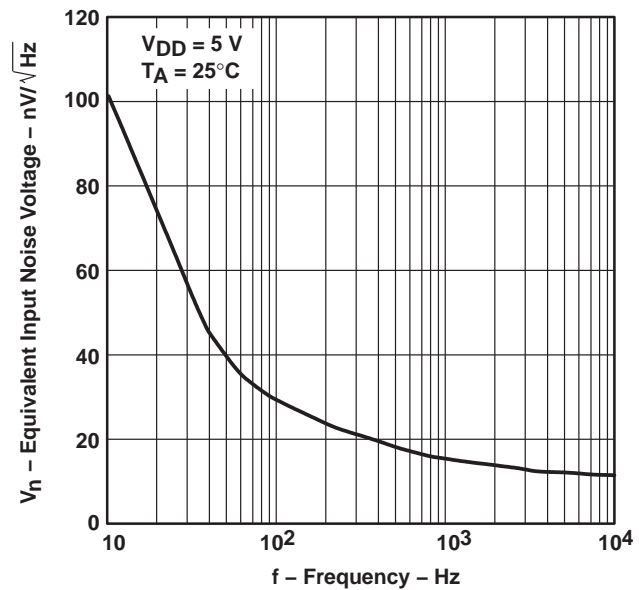
**Figure 40**

**EQUIVALENT INPUT NOISE VOLTAGE VS FREQUENCY**



**Figure 41**

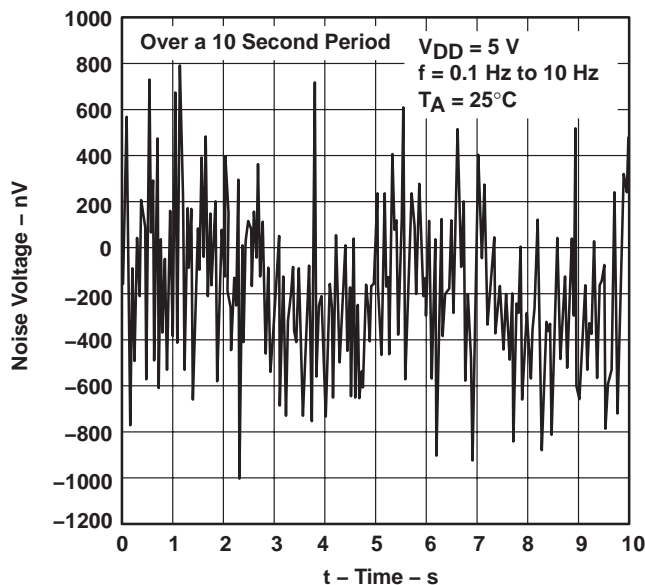
**EQUIVALENT INPUT NOISE VOLTAGE VS FREQUENCY**



**Figure 42**

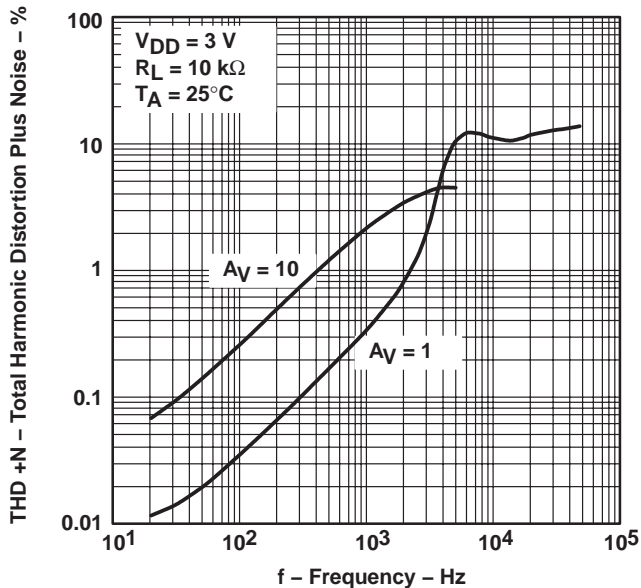
**TYPICAL CHARACTERISTICS**

**NOISE VOLTAGE OVER A 10-SECOND PERIOD**



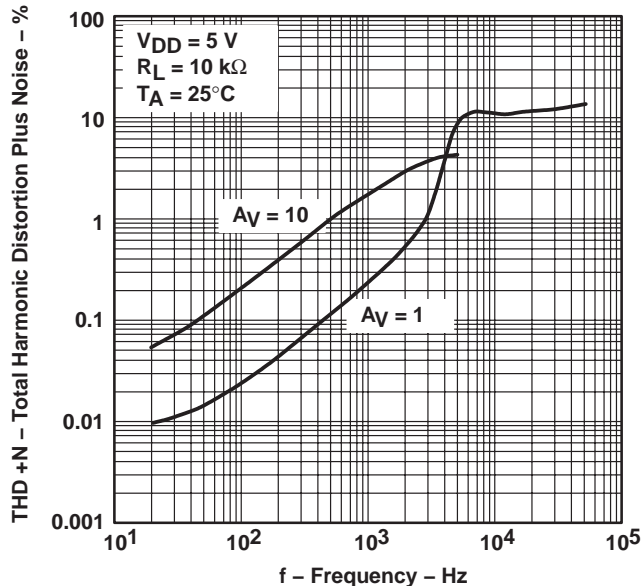
**Figure 43**

**TOTAL HARMONIC DISTORTION PLUS NOISE  
vs  
FREQUENCY**



**Figure 44**

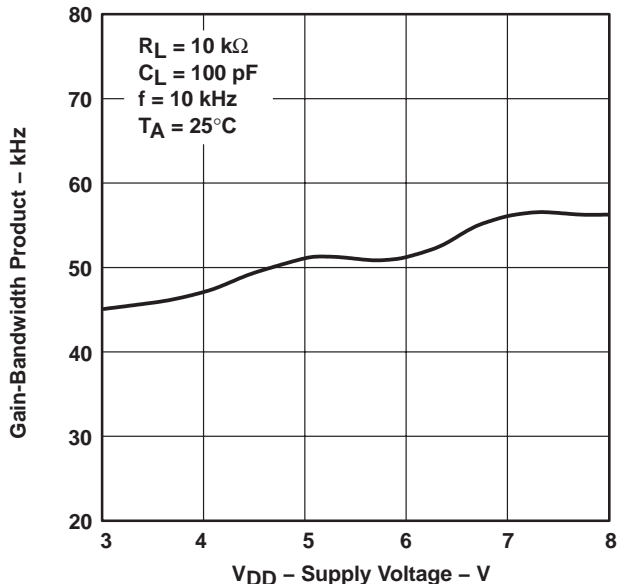
**TOTAL HARMONIC DISTORTION PLUS NOISE  
vs  
FREQUENCY**



**Figure 45**

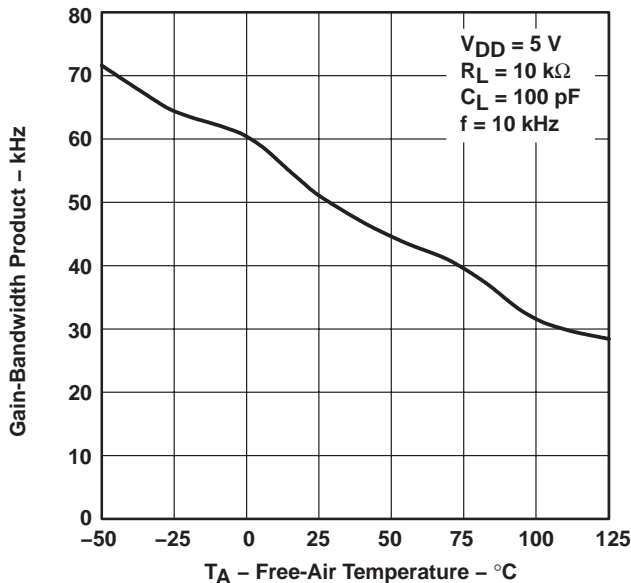
**TYPICAL CHARACTERISTICS**

**GAIN-BANDWIDTH PRODUCT  
 vs  
 SUPPLY VOLTAGE**



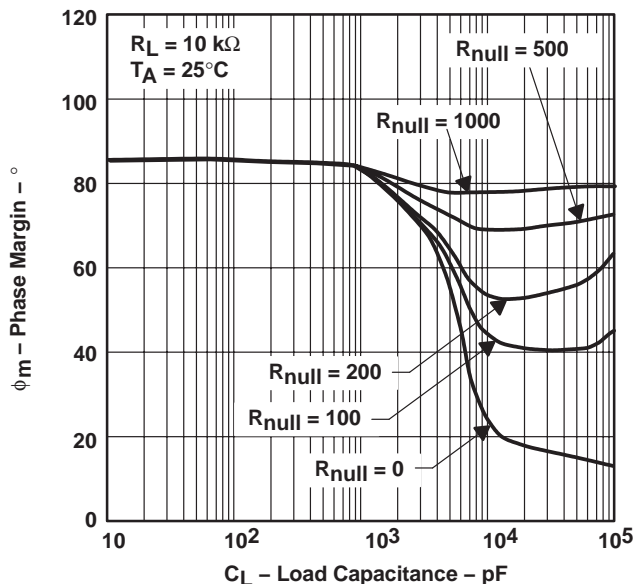
**Figure 46**

**GAIN-BANDWIDTH PRODUCT  
 vs  
 FREE-AIR TEMPERATURE**



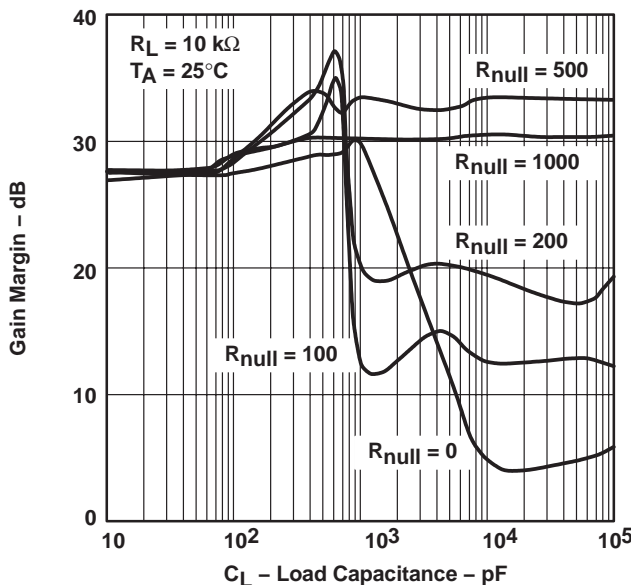
**Figure 47**

**PHASE MARGIN  
 vs  
 LOAD CAPACITANCE**



**Figure 48**

**GAIN MARGIN  
 vs  
 LOAD CAPACITANCE**



**Figure 49**

TYPICAL CHARACTERISTICS

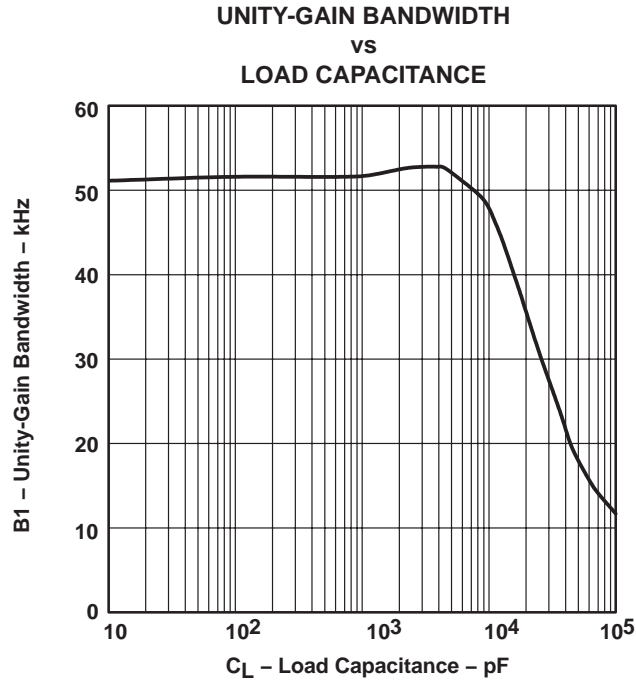


Figure 50

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TLV2422AQDRG4Q1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2422AQDRQ1	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
TLV2422QDRG4Q1	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLV2422QDRQ1	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> 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 TLV2422-Q1, TLV2422A-Q1 :**

- Catalog: [TLV2422](#), [TLV2422A](#)
- Military: [TLV2422M](#), [TLV2422AM](#)

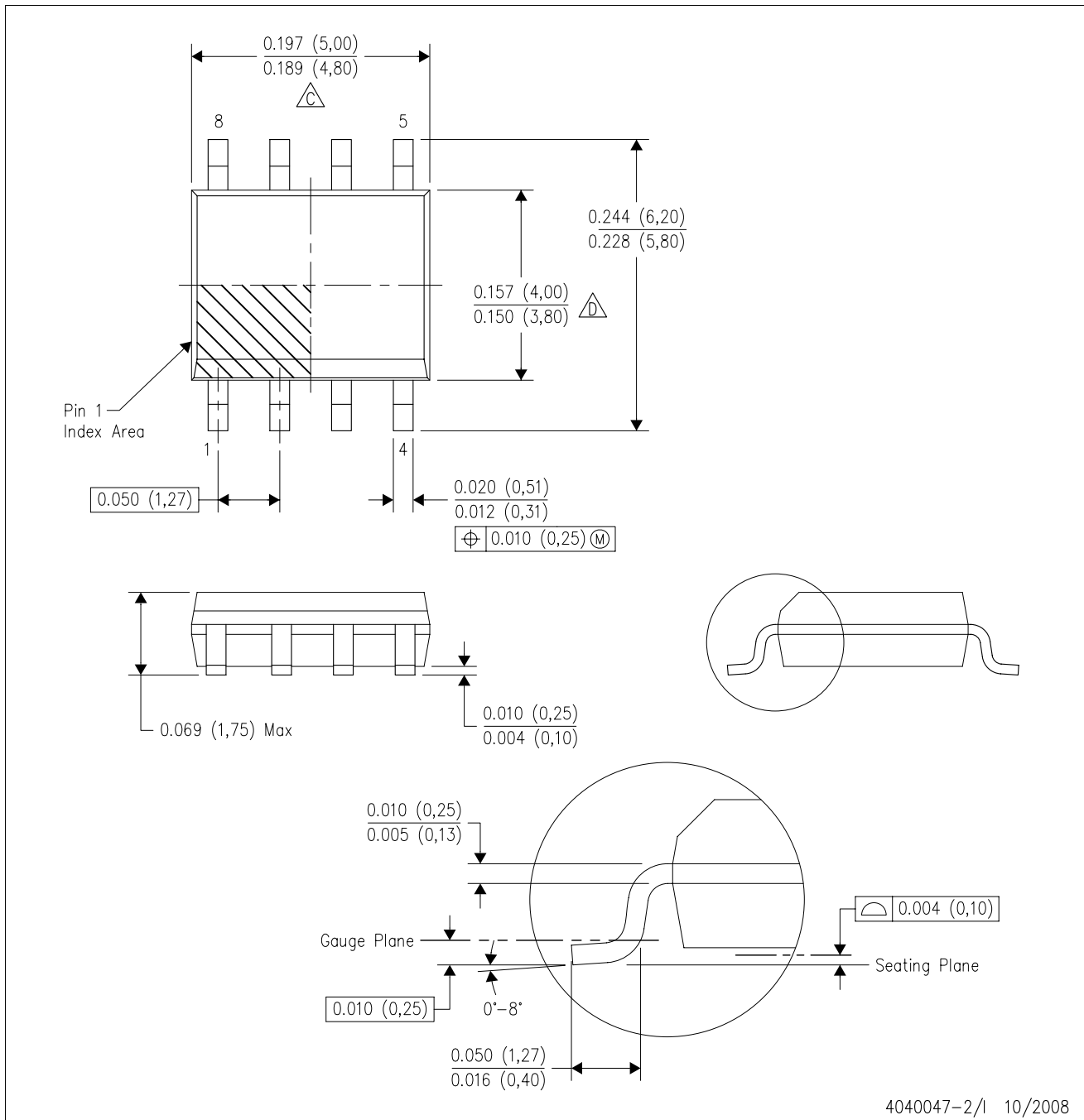
NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications



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.

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Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
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