

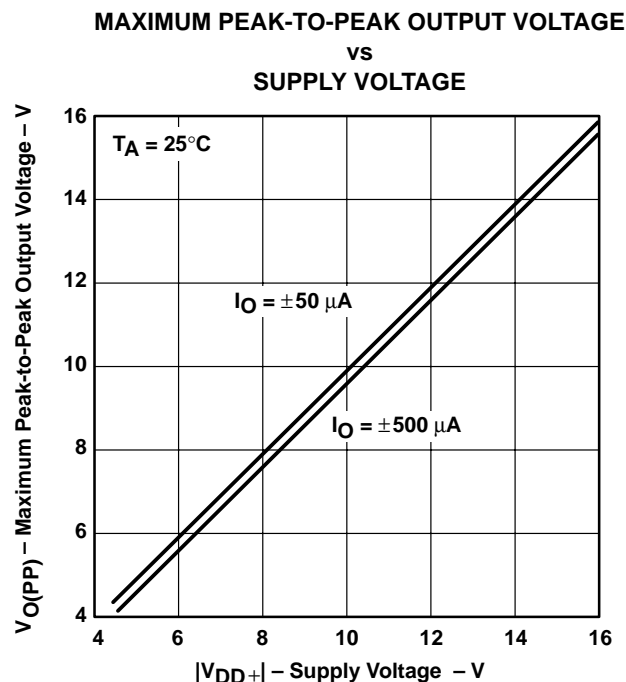
- Output Swing Includes Both Supply Rails
- Low Noise . . . 9 nV/√Hz Typ at f = 1 kHz
- Low Input Bias Current . . . 1 pA Typ
- Fully Specified for Both Single-Supply and Split-Supply Operation
- Common-Mode Input Voltage Range Includes Negative Rail
- High-Gain Bandwidth . . . 2.2 MHz Typ
- High Slew Rate . . . 3.6 V/μs Typ
- Low Input Offset Voltage  
950 μV Max at T<sub>A</sub> = 25°C
- Macromodel Included
- Performance Upgrades for the TS272, TS274, TLC272, and TLC274

## description

The TLC2272 and TLC2274 are dual and quadruple operational amplifiers from Texas Instruments. Both devices exhibit rail-to-rail output performance for increased dynamic range in single- or split-supply applications. The TLC227x family offers 2 MHz of bandwidth and 3 V/μs of slew rate for higher speed applications. These devices offer comparable ac performance while having better noise, input offset voltage, and power dissipation than existing CMOS operational amplifiers. The TLC227x has a noise voltage of 9 nV/√Hz; two times lower than competitive solutions.

The TLC227x, exhibiting high input impedance and low noise, is excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the micro-power dissipation levels, 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 TLC227xA family is available and has a maximum input offset voltage of 950 μV. This family is fully characterized at 5 V and ±5 V.

The TLC2272/4 also makes great upgrades to the TLC272/4 or TS272/4 in standard designs. They offer increased output dynamic range, lower noise voltage and lower input offset voltage. This enhanced feature set allows them to be used in a wider range of applications. For applications that require higher output drive and wider input voltage range, see TLV2432 and TLV2442 devices. If the design requires single amplifiers, please see the TLV2211/21/31 family. These devices are single rail-to-rail operational amplifiers in the SOT-23 package. Their small size and low power consumption, make them ideal for high density, battery-powered equipment.



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# TLC227x, TLC227xA, TLC227xY

## Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

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### TLC2272 AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IO</sub> max At 25°C	PACKAGED DEVICES			CHIP FORM§ (Y)
		SMALL OUTLINE† (D)	PLASTIC DIP (P)	TSSOP‡ (PW)	
0°C to 70°C	950 μV 2.5 mV	TLC2272ACD TLC2272CD	TLC2272ACP TLC2272CP	TLC2272CPWLE	TLC2272Y
-40°C to 85°C	950 μV 2.5 mV	TLC2272AID TLC2272ID	TLC2272AIP TLC2272IP	—	—
-55°C to 125°C	950 μV 2.5 mV	TLC2272AMD TLC2272MD	TLC2272AMP TLC2272MP	—	—

† The D packages are available taped and reeled. Add R suffix to the device type (e.g., TLC2272CDR).

‡ The PW package is available only left-end taped and reeled.

§ Chips are tested at 25°C.

### TLC2274 AVAILABLE OPTIONS

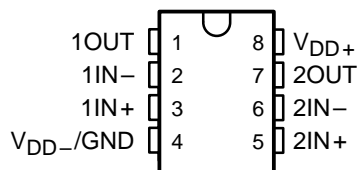
T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGED DEVICES					CHIP FORM§ (Y)
		SMALL OUTLINE† (D)	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	TSSOP‡ (PW)	
0°C to 70°C	950 μV 2.5 mV	TLC2274ACD TLC2274CD	—	—	TLC2274ACN TLC2274CN	— TLC2274CPWLE	TLC2274Y
-40°C to 85°C	950 μV 2.5 mV	TLC2274AID TLC2274ID	—	—	TLC2274AIN TLC2274IN	— TLC2274IPWLE	—
-55°C to 125°C	950 μV 2.5 mV	TLC2274AMD TLC2274MD	TLC2274AMFK TLC2274MFK	TLC2274AMJ TLC2274MJ	TLC2274AMN TLC2274MN	—	—

† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLC2274CDR).

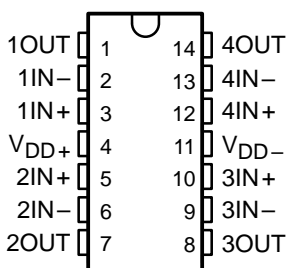
‡ The PW package is available only left-end taped and reeled.

§ Chips are tested at 25°C.

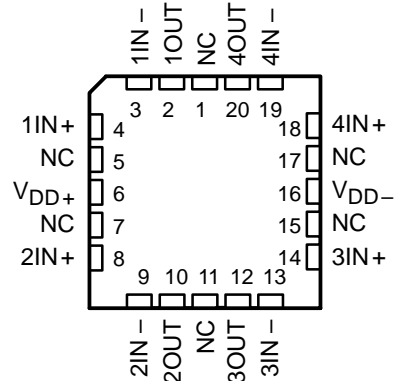
**TLC2272**  
D, P, OR PW PACKAGE  
(TOP VIEW)



**TLC2274**  
D, J, N, OR PW PACKAGE  
(TOP VIEW)



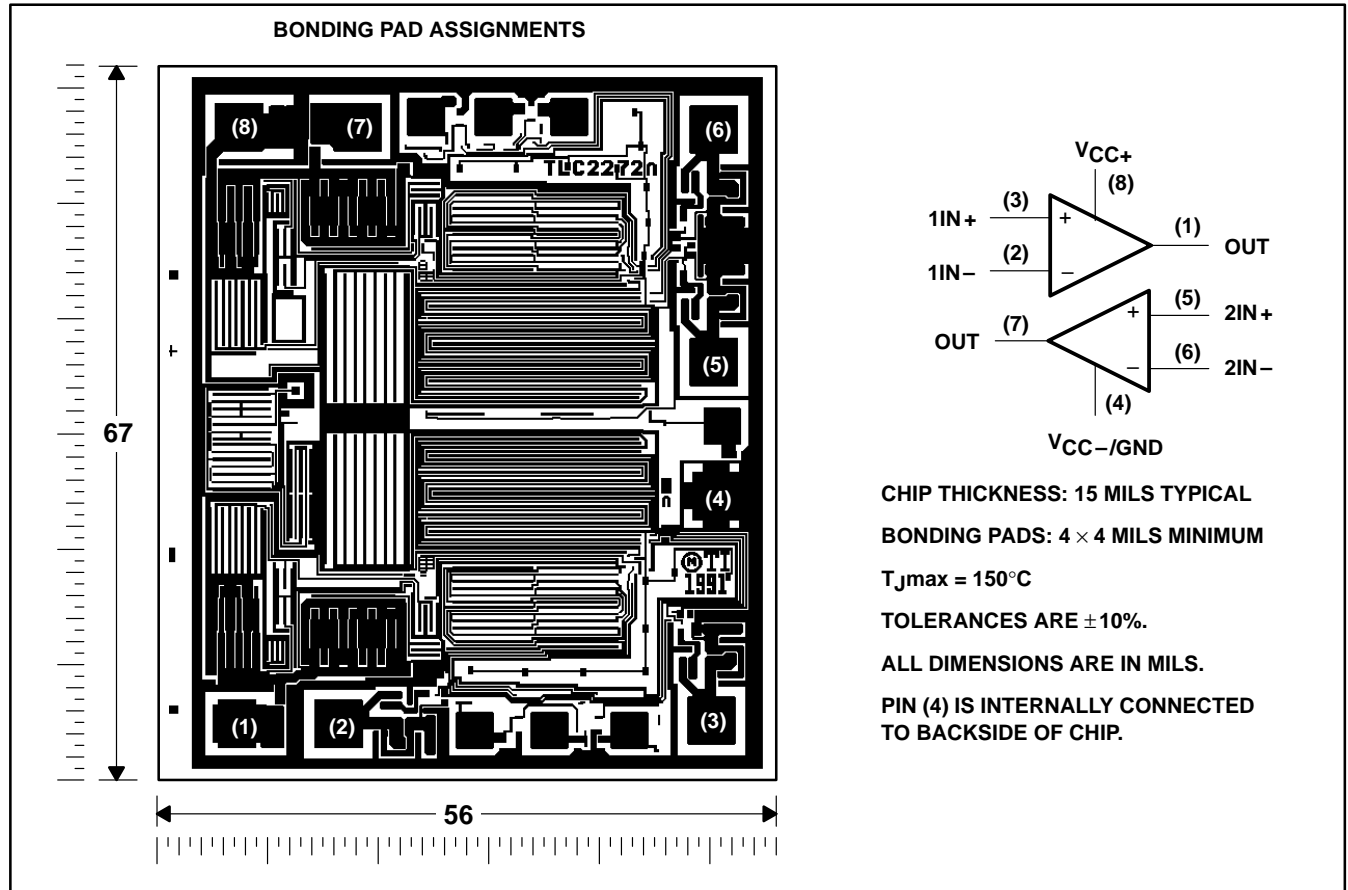
**TLC2274**  
FK PACKAGE  
(TOP VIEW)



NC – No internal connection

### TLC2272Y chip information

These chips, when properly assembled, display characteristics similar to the TLC2272C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.

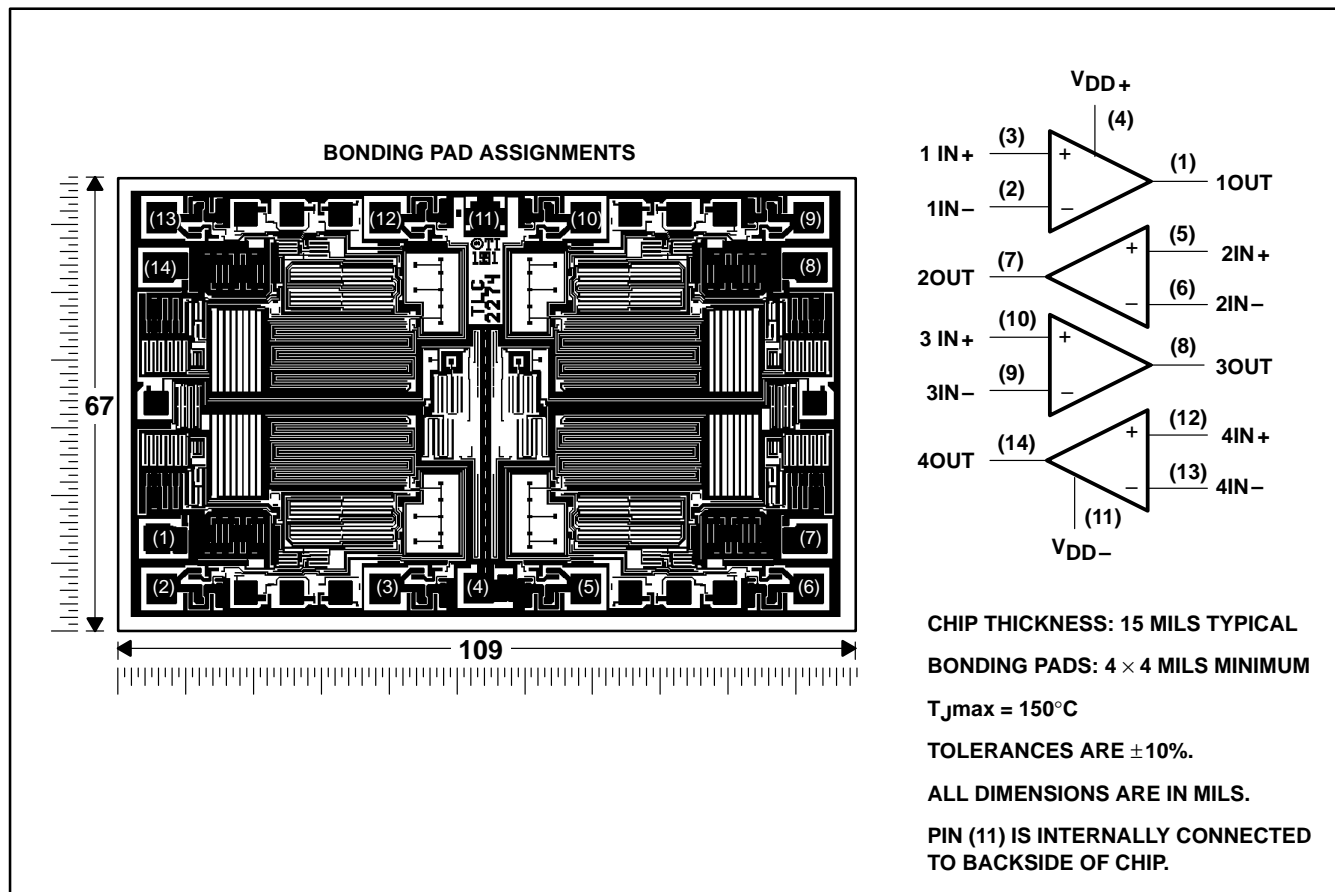


# TLC227x, TLC227xA, TLC227xY Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

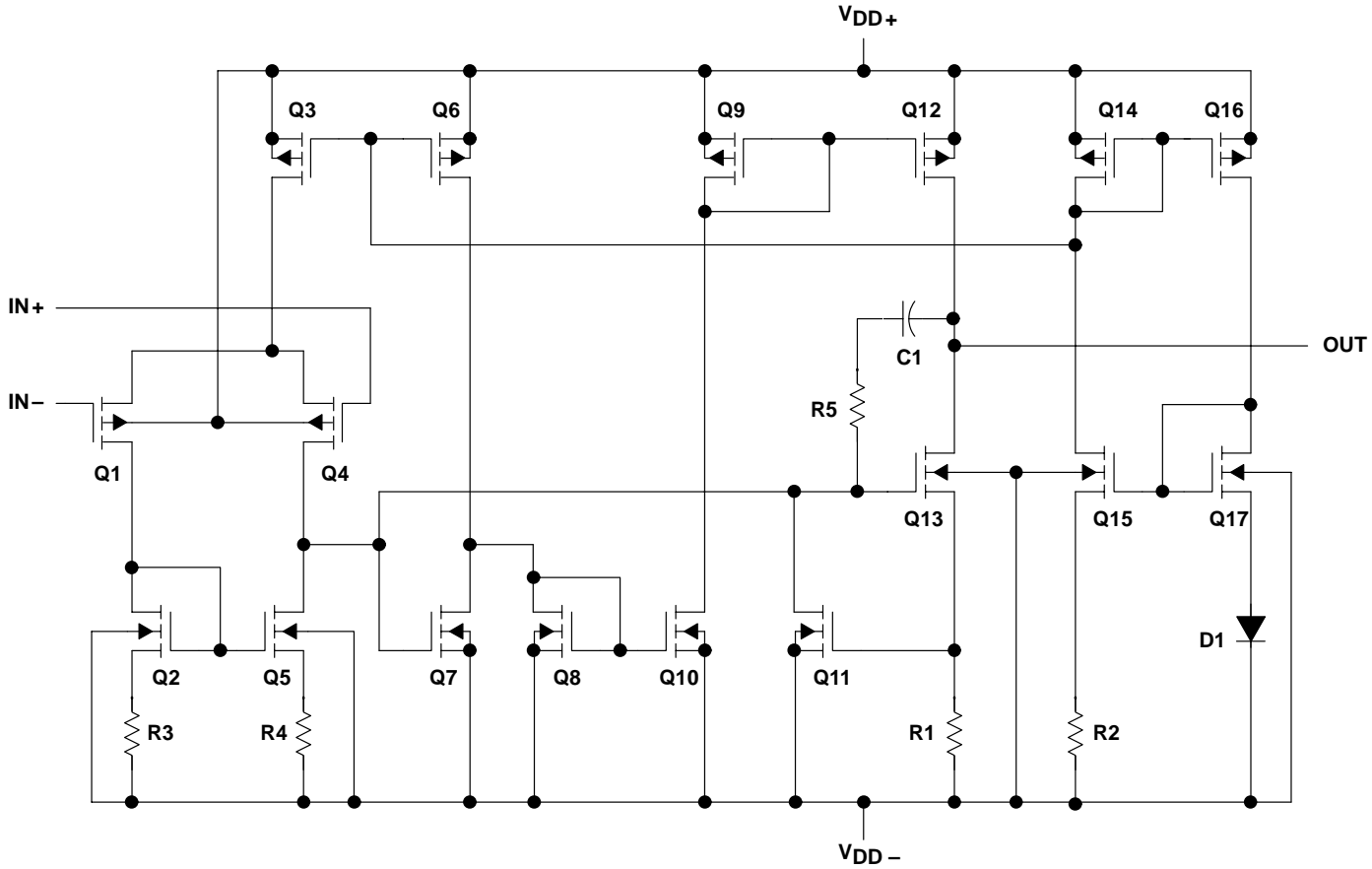
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## TLC2274Y chip information

This chip, when properly assembled, displays characteristics similar to the TLC2274C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



equivalent schematic (each amplifier)



ACTUAL DEVICE COMPONENT COUNT†		
COMPONENT	TLC2272	TLC2274
Transistors	38	76
Resistors	26	52
Diodes	9	18
Capacitors	3	6

† Includes both amplifiers and all ESD, bias, and trim circuitry

# TLC227x, TLC227xA, TLC227xY Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

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

Supply voltage, $V_{DD+}$ (see Note 1)	8 V
Supply voltage, $V_{DD-}$ (see Note 1)	-8 V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm 16$ V
Input voltage, $V_I$ (any input, see Note 1)	$V_{DD-} - 0.3$ V to $V_{DD+}$
Input current, $I_I$ (any 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 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	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, N, P or PW package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J 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.

- 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 will flow 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-8	725 mW	5.8 mW/°C	464 mW	337 mW	145 mW
D-14	950 mW	7.6 mW/°C	608 mW	494 mW	190 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
J	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW	230 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW
PW-8	525 mW	4.2 mW/°C	336 mW	—	—
PW-14	700 mW	5.6 mW/°C	448 mW	364 mW	—

## recommended operating conditions

	C SUFFIX		I SUFFIX		M SUFFIX		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{DD\pm}$	$\pm 2.2$	$\pm 8$	$\pm 2.2$	$\pm 8$	$\pm 2.2$	$\pm 8$	V
Input voltage range, $V_I$	$V_{DD-}$	$V_{DD+} - 1.5$	$V_{DD-}$	$V_{DD+} - 1.5$	$V_{DD-}$	$V_{DD+} - 1.5$	V
Common-mode input voltage, $V_{IC}$	$V_{DD-}$	$V_{DD+} - 1.5$	$V_{DD-}$	$V_{DD+} - 1.5$	$V_{DD-}$	$V_{DD+} - 1.5$	V
Operating free-air temperature, $T_A$	0	70	-40	85	-55	125	°C



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**TLC2272C electrical characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272C			TLC2272AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage		25°C	300		2500	300		950	$\mu\text{V}$	
		Full range	3000			1500				
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 70°C	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	0.002			0.002			$\mu\text{V}/\text{mo}$
$I_{IO}$ Input offset current		25°C	0.5			0.5			$\text{pA}$	
		Full range	100			100				
$I_{IB}$ Input bias current		25°C	1			1			$\text{pA}$	
		Full range	100			100				
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega,$	$ V_{IO}  \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2	0 to 4	-0.3 to 4.2	$\text{V}$		
			Full range	0 to 3.5		0 to 3.5				
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$		25°C	4.99		4.99		$\text{V}$		
			25°C	4.85	4.93	4.85	4.93			
			Full range	4.85		4.85				
			25°C	4.25	4.65	4.25	4.65			
$V_{OL}$ Low-level output voltage	$I_{OL} = 50\ \mu\text{A}$		25°C	0.01		0.01		$\text{V}$		
			25°C	0.09	0.15	0.09	0.15			
			Full range	0.15		0.15				
			25°C	0.9	1.5	0.9	1.5			
$V_{OL}$ Low-level output voltage	$I_{OL} = 500\ \mu\text{A}$		25°C	0.01		0.01		$\text{V}$		
			25°C	0.09	0.15	0.09	0.15			
			Full range	0.15		0.15				
			25°C	0.9	1.5	0.9	1.5			
$V_{OL}$ Low-level output voltage	$I_{OL} = 5\text{ mA}$		25°C	0.01		0.01		$\text{V}$		
			25°C	0.09	0.15	0.09	0.15			
			Full range	0.15		0.15				
			25°C	0.9	1.5	0.9	1.5			
$A_{VD}$ 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	15	35	15	35	$\text{V}/\text{mV}$		
			Full range	15		15				
			25°C	175			175			
$r_{id}$ Differential input resistance			25°C	$10^{12}$			$\Omega$			
			25°C	$10^{12}$			$\Omega$			
$r_i$ Common-mode input resistance			25°C	$10^{12}$			$\Omega$			
			25°C	$10^{12}$			$\Omega$			
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz},$	P package	25°C	8			8		$\text{pF}$	
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz},$	$A_V = 10$	25°C	140			140		$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V},$ $V_O = 2.5\text{ V},$	$R_S = 50\ \Omega$	25°C	70	75	70	75	dB		
			Full range	70			70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }16\text{ V},$ $V_{IC} = V_{DD}/2,$	No load	25°C	80	95	80	95	dB		
			Full range	80			80			
$I_{DD}$ Supply current	$V_O = 2.5\text{ V},$	No load	25°C	2.2	3	2.2	3	mA		
			Full range	3			3			

† Full range is 0°C to 70°C.

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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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**TLC2272C operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272C			TLC2272AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain $V_O = 0.5\text{ V to }2.5\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.3	3.6		2.3	3.6		V/ $\mu$ s
		Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage $f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C		50			50		nV/ $\sqrt{\text{Hz}}$
		25°C		9			9		
$V_{NPP}$	Peak-to-peak equivalent input noise voltage $f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$	25°C		1			1		$\mu$ V
		25°C		1.4			1.4		
$I_n$	Equivalent input noise current	25°C		0.6			0.6		fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise $V_O = 0.5\text{ V to }2.5\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega$ ‡	25°C	$A_V = 1$	0.0013%		0.0013%			
			$A_V = 10$	0.004%		0.004%			
			$A_V = 100$	0.03%		0.03%			
	Gain-bandwidth product $f = 10\text{ kHz}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C		2.18			2.18		MHz
BOM	Maximum output-swing bandwidth $V_{O(PP)} = 2\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $A_V = 1$ , $C_L = 100\text{ pF}$ ‡	25°C		1			1		MHz
$t_s$	Settling time $A_V = -1$ , Step = 0.5 V to 2.5 V, $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	To 0.1%	1.5		1.5			$\mu$ s
			To 0.01%	2.6		2.6			
$\phi_m$	Phase margin at unity gain $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C		50°			50°		
		25°C		10			10		dB

† Full range is 0°C to 70°C.

‡ Referenced to 2.5 V





**TLC227x, TLC227xA, TLC227xY**  
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**TLC2272C electrical characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5$  V (unless otherwise specified)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272C			TLC2272AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage		25°C	300 2500			300 950			$\mu$ V
		Full range	3000			1500			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 70°C	2			2			$\mu$ V/°C
Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0, V_O = 0, R_S = 50 \Omega$	25°C	0.002			0.002			$\mu$ V/mo
$I_{IO}$ Input offset current		25°C	0.5			0.5			pA
		Full range	100			100			
$I_{IB}$ Input bias current		25°C	1			1			pA
		Full range	100			100			
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega,  V_{IO}  \leq 5$ mV	25°C	-5 to 4	-5.3 to 4.2	-5 to 4	-5.3 to 4.2			V
		Full range	-5 to 3.5		-5 to 3.5				
$V_{OM+}$ Maximum positive peak output voltage	$I_O = -20 \mu$ A	25°C	4.99			4.99			V
		25°C	4.85	4.93	4.85	4.93			
		Full range	4.85			4.85			
		25°C	4.25	4.65	4.25	4.65			
$V_{OM-}$ Maximum negative peak output voltage	$I_O = -1$ mA	25°C	-4.99			-4.99			V
		25°C	-4.85	-4.91	-4.85	-4.91			
		Full range	-4.85			-4.85			
		25°C	-3.5	-4.1	-3.5	-4.1			
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 4$ V	$R_L = 10$ k $\Omega$	25°C	25	50	25	50		
			Full range	25			25		
		$R_L = 1$ m $\Omega$	25°C	300			300		
			Full range	300			300		
$r_{id}$ Differential input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$r_i$ Common-mode input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$c_i$ Common-mode input capacitance	$f = 10$ kHz, P package	25°C	8			8			pF
$z_o$ Closed-loop output impedance	$f = 1$ MHz, $A_V = 10$	25°C	130			130			$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = -5$ to 2.7 V, $V_O = 0$ V, $R_S = 50 \Omega$	25°C	75	80	75	80			
		Full range	75			75			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD\pm} / \Delta V_{IO}$ )	$V_{DD\pm} = 2.2$ V to $\pm 8$ V, $V_{IC} = 0$ , No load	25°C	80	95	80	95			
		Full range	80			80			
$I_{DD}$ Supply current	$V_O = 0$ V No load	25°C	2.4 3			2.4 3			mA
		Full range	3			3			

† Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at  $T_A = 150^\circ$ C extrapolated to  $T_A = 25^\circ$ C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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**TLC2272C operating characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272C			TLC2272AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain $V_O = \pm 2.3\text{ V}$ , $C_L = 100\text{ pF}$ $R_L = 10\text{ k}\Omega$	25°C	2.3	3.6		2.3	3.6	V/ $\mu$ s	
		Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage $f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C		50			50	nV/ $\sqrt{\text{Hz}}$	
		25°C		9			9		
$V_{NPP}$	Peak-to-peak equivalent input noise voltage $f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$	25°C		1			1	$\mu$ V	
		25°C		1.4			1.4		
$I_n$	Equivalent input noise current	25°C		0.6			0.6	fA/ $\sqrt{\text{Hz}}$	
THD + N	Total harmonic distortion pulse duration $V_O = \pm 2.3\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega$	$A_V = 1$	25°C	0.0011%		0.0011%			
		$A_V = 10$		0.004%		0.004%			
		$A_V = 100$		0.03%		0.03%			
	Gain-bandwidth product $f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$ $R_L = 10\text{ k}\Omega$	25°C		2.25			2.25	MHz	
BOM	Maximum output-swing bandwidth $V_O(PP) = 4.6\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $A_V = 1$ , $C_L = 100\text{ pF}$	25°C		0.54			0.54	MHz	
$t_s$	Settling time $A_V = -1$ , Step = $-2.3\text{ V to }2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 0.1%	25°C	1.5		1.5		$\mu$ s	
		To 0.01%		3.2		3.2			
$\phi_m$	Phase margin at unity gain $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	25°C		52°			52°		
		25°C		10			10	dB	

† Full range is 0°C to 70°C.



**TLC2274C electrical characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274C			TLC2274AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage		25°C	300	2500		300	950	$\mu\text{V}$	
		Full range		3000		1500			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 70°C	2			2			$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)	$V_{DD\pm} = \pm 2.5\text{ V}$ , $V_{IC} = 0$ , $V_O = 0$ , $R_S = 50\ \Omega$	25°C	0.002			0.002			$\mu\text{V}/\text{mo}$
$I_{IO}$ Input offset current		25°C	0.5			0.5			$\text{pA}$
		Full range	100			100			
$I_{IB}$ Input bias current		25°C	1			1			$\text{pA}$
	Full range	100			100				
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$ , $ V_{IO}  \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2	V	
		Full range	0 to 3.5			0 to 3.5			
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C	4.99			4.99			V
	$I_{OH} = -200\ \mu\text{A}$	25°C	4.85	4.93		4.85	4.93		
		Full range	4.85			4.85			
	$I_{OH} = -1\ \text{mA}$	25°C	4.25	4.65		4.25	4.65		
Full range		4.25			4.25				
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 50\ \mu\text{A}$	25°C	0.01			0.01			V
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 500\ \mu\text{A}$	25°C	0.09	0.15		0.09	0.15		
		Full range	0.15			0.15			
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 5\ \text{mA}$	25°C	0.9	1.5		0.9	1.5		
Full range		1.5			1.5				
$A_{VD}$ 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	15	35		15	35	V/mV
			Full range	15			15		
		$R_L = 1\ \text{m}\Omega$ ‡	25°C	175			175		
$r_{id}$ Differential input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$r_i$ Common-mode input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$c_i$ Common-mode input capacitance	$f = 10\ \text{kHz}$ , N package	25°C	8			8			$\text{pF}$
$z_o$ Closed-loop output impedance	$f = 1\ \text{MHz}$ , $A_V = 10$	25°C	140			140			$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to } 2.7\text{ V}$ , $V_O = 2.5\text{ V}$ , $R_S = 50\ \Omega$	25°C	70	75		70	75	dB	
		Full range	70			70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to } 16\text{ V}$ , $V_{IC} = V_{DD}/2$ , No load	25°C	80	95		80	95	dB	
		Full range	80			80			
$I_{DD}$ Supply current	$V_O = 2.5\text{ V}$ , No load	25°C	4.4	6		4.4	6	mA	
		Full range	6			6			

† Full range is 0°C to 70°C.

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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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**TLC2274C operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

PARAMETER	TEST CONDITIONS		$T_A$ †	TLC2274C			TLC2274AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = 0.5\text{ V to }2.5\text{ V}$ , $R_L = 10\text{ k}\Omega^\ddagger$ , $C_L = 100\text{ pF}^\ddagger$	25°C	2.3	3.6		2.3	3.6	V/ $\mu\text{s}$	
			Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage	$f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C		50			50	nV/ $\sqrt{\text{Hz}}$	
			25°C		9			9		
$V_N(\text{PP})$	Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ to }1\text{ Hz}$ $f = 0.1\text{ to }10\text{ Hz}$	25°C		1			1	$\mu\text{V}$	
			25°C		1.4			1.4		
$I_n$	Equivalent input noise current		25°C		0.6			0.6	fA/ $\sqrt{\text{Hz}}$	
THD + N	Total harmonic distortion plus noise	$V_O = 0.5\text{ V to }2.5\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega^\ddagger$	25°C	$A_V = 1$		0.0013%		0.0013%		
				$A_V = 10$		0.004%		0.004%		
				$A_V = 100$		0.03%		0.03%		
	Gain-bandwidth product	$f = 10\text{ kHz}$ , $C_L = 100\text{ pF}^\ddagger$	25°C		2.18			2.18	MHz	
BOM	Maximum output-swing bandwidth	$V_O(\text{PP}) = 2\text{ V}$ , $R_L = 10\text{ k}\Omega^\ddagger$ , $C_L = 100\text{ pF}^\ddagger$	25°C		1			1	MHz	
$t_s$	Settling time	$A_V = -1$ , Step = 0.5 V to 2.5 V, $R_L = 10\text{ k}\Omega^\ddagger$ , $C_L = 100\text{ pF}^\ddagger$	25°C	To 0.1%		1.5		1.5	$\mu\text{s}$	
				To 0.01%		2.6		2.6		
$\phi_m$	Phase margin at unity gain	$R_L = 10\text{ k}\Omega^\ddagger$ , $C_L = 100\text{ pF}^\ddagger$	25°C		50°			50°		
	Gain margin		25°C		10		10	dB		

† Full range is 0°C to 70°C.

‡ Referenced to 2.5 V



**TLC2274C electrical characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274C			TLC2274AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	25°C	300	2500		300	950	$\mu\text{V}$		
		Full range			3000		1500			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 70°C		2			2	$\mu\text{V}/^\circ\text{C}$		
Input offset voltage long-term drift (see Note 4)		25°C		0.002			0.002	$\mu\text{V}/\text{mo}$		
$I_{IO}$ Input offset current		25°C		0.5			0.5	$\text{pA}$		
		Full range			100		100			
$I_{IB}$ Input bias current	25°C		1			1	$\text{pA}$			
	Full range			100		100				
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega,  V_{IO}  \leq 5\ \text{mV}$	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2	V		
		Full range	-5 to 3.5			-5 to 3.5				
$V_{OM+}$ Maximum positive peak output voltage	$I_O = -20\ \mu\text{A}$	25°C		4.99			4.99	V		
		25°C		4.85	4.93		4.85		4.93	
		Full range		4.85			4.85			
		25°C		4.25	4.65		4.25		4.65	
$V_{OM-}$ Maximum negative peak output voltage	$I_O = -1\ \text{mA}$	25°C		-4.9			-4.9	V		
		25°C		-4.8	-4.9		-4.8		-4.9	
		Full range		-4.8			-4.8			
		25°C		-3.5	-4.1		-3.5		-4.1	
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 4\ \text{V}$	$R_L = 10\ \text{k}\Omega$	25°C	25	50		25	50	V/mV	
			Full range		25			25		
		$R_L = 1\ \text{M}\Omega$	25°C		300			300		
			Full range							
$r_{id}$ Differential input resistance		25°C		$10^{12}$			$10^{12}$	$\Omega$		
$r_i$ Common-mode input resistance		25°C		$10^{12}$			$10^{12}$	$\Omega$		
$c_i$ Common-mode input capacitance	$f = 10\ \text{kHz}, N$ package	25°C		8			8	pF		
$z_o$ Closed-loop output impedance	$f = 1\ \text{MHz}, A_V = 10$	25°C		130			130	$\Omega$		
CMRR Common-mode rejection ratio	$V_{IC} = -5\ \text{V to } 2.7\ \text{V}, V_O = 0, R_S = 50\ \Omega$	25°C	75	80		75	80	dB		
		Full range		75			75			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{DD\pm} = \pm 2.2\ \text{V to } \pm 8\ \text{V}, V_{IC} = 0, \text{No load}$	25°C	80	95		80	95	dB		
		Full range		80			80			
$I_{DD}$ Supply current	$V_O = 0, \text{No load}$	25°C		4.8	6		4.8	6	mA	
		Full range			6			6		

† Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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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**TLC2274C operating characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS		$T_A$ †	TLC2274C			TLC2274AC			UNIT	
				MIN	TYP	MAX	MIN	TYP	MAX		
SR	Slew rate at unity gain	$V_O = \pm 2.3\text{ V}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	2.3	3.6		2.3	3.6	V/ $\mu\text{s}$	
				Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage			25°C	50			50			nV/ $\sqrt{\text{Hz}}$
				25°C	9			9			
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage			25°C	1			1			$\mu\text{V}$
				25°C	1.4			1.4			
$I_n$	Equivalent input noise current			25°C	0.6			0.6			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega$		25°C	$A_V = 1$			0.0011%			
					$A_V = 10$			0.004%			
					$A_V = 100$			0.03%			
	Gain-bandwidth product	$f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	2.25			2.25			MHz
BOM	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6\text{ V}$ , $R_L = 10\text{ k}\Omega$	$A_V = 1$ , $C_L = 100\text{ pF}$	25°C	0.54			0.54			MHz
$t_s$	Settling time	$A_V = -1$ , Step = $-2.3\text{ V}$ to $2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 0.1%	25°C	1.5			1.5			$\mu\text{s}$
			To 0.01%		3.2			3.2			
$\phi_m$	Phase margin at unity gain	$R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$		25°C	52°			52°			
	Gain margin			25°C	10			10			

† Full range is 0°C to 70°C.



**TLC2272I electrical characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272I			TLC2272AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage		25°C	300	2500		300	950	$\mu\text{V}$	
		Full range			3000		1500		
$\alpha_{VIO}$ Temperature coefficient of input offset voltage	$V_{IC} = 0,$ $V_O = 0,$ $V_{DD\pm} = \pm 2.5\text{ V}$ $R_S = 50\ \Omega$	25°C to 85°C	2			2			$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)		25°C	0.002			0.002			$\mu\text{V}/\text{mo}$
$I_{IO}$ Input offset current		25°C	0.5			0.5			$\text{pA}$
		Full range	150			150			
$I_{IB}$ Input bias current	25°C	1			1			$\text{pA}$	
	Full range	150			150				
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega,$ $ V_{IO}  \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2	V	
		Full range	0 to 3.5			0 to 3.5			
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$ $I_{OH} = -200\ \mu\text{A}$ $I_{OH} = -1\text{ mA}$	25°C	4.99			4.99			V
		25°C	4.85	4.93		4.85	4.93		
		Full range	4.85			4.85			
		25°C	4.25	4.65		4.25	4.65		
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\text{ V},$ $I_{OL} = 50\ \mu\text{A}$ $V_{IC} = 2.5\text{ V},$ $I_{OL} = 500\ \mu\text{A}$ $V_{IC} = 2.5\text{ V},$ $I_{OL} = 5\text{ mA}$	25°C	0.01			0.01			V
		25°C	0.09	0.15		0.09	0.15		
		Full range	0.15			0.15			
		25°C	0.9	1.5		0.9	1.5		
$A_{VD}$ 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	15	35		15	35	V/mV
			Full range	15			15		
		$R_L = 1\text{ m}\Omega$ ‡	25°C	175			175		
$r_{id}$ Differential input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$r_i$ Common-mode input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz},$ P package	25°C	8			8			$\text{pF}$
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz},$ $A_V = 10$	25°C	140			140			$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V},$ $V_O = 2.5\text{ V},$ $R_S = 50\ \Omega$	25°C	70	75		70	75	dB	
		Full range	70			70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }16\text{ V},$ $V_{IC} = V_{DD}/2,$ No load	25°C	80	95		80	95	dB	
		Full range	80			80			
$I_{DD}$ Supply current	$V_O = 2.5\text{ V},$ No load	25°C	2.2	3		2.2	3	mA	
		Full range	3			3			

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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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**TLC2272I operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272I			TLC2272AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain $V_O = 0.5\text{ V to }2.5\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.3	3.6		2.3	3.6	V/ $\mu\text{s}$	
		Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage $f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C	50			50			nV/ $\sqrt{\text{Hz}}$
		25°C	9			9			
$V_{NPP}$	Peak-to-peak equivalent input noise voltage $f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$	25°C	1			1			$\mu\text{V}$
		25°C	1.4			1.4			
$I_n$	Equivalent input noise current	25°C	0.6			0.6			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise $V_O = 0.5\text{ V to }2.5\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega$ ‡	25°C	$A_V = 1$			0.0013%			
			$A_V = 10$			0.004%			
			$A_V = 100$			0.03%			
	Gain-bandwidth product $f = 10\text{ kHz}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.18			2.18			MHz
BOM	Maximum output-swing bandwidth $V_{O(PP)} = 2\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $A_V = 1$ , $C_L = 100\text{ pF}$ ‡	25°C	1			1			MHz
$t_s$	Settling time $A_V = -1$ , Step = 0.5 V to 2.5 V, $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	$T_o$ 0.1%			1.5			$\mu\text{s}$
			$T_o$ 0.01%			2.6			
$\phi_m$	Phase margin at unity gain $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	50°			50°			
		25°C	10			10			

† Full range is – 40°C to 85°C.

‡ Referenced to 2.5 V





**TLC2272I electrical characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272I			TLC2272AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega$	$V_O = 0,$	25°C	300	2500	300	950	$\mu\text{V}$	
			Full range	3000		1500			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage			25°C to 85°C	2		2		$\mu\text{V}/^\circ\text{C}$	
			25°C	0.002		0.002		$\mu\text{V}/\text{mo}$	
$I_{IO}$ Input offset current			25°C	0.5		0.5		$\text{pA}$	
			Full range	150		150			
$I_{IB}$ Input bias current	25°C	1		1		$\text{pA}$			
	Full range	150		150					
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega,$	$ V_{IO}  \leq 5\text{ mV}$	25°C	-5 to 4	-5.3 to 4.2	-5 to 4	-5.3 to 4.2	$\text{V}$	
			Full range	-5 to 3.5	-5 to 3.5	-5 to 3.5	-5 to 3.5		
$V_{OM+}$ Maximum positive peak output voltage	$I_O = -20\ \mu\text{A}$	25°C	4.99		4.99		$\text{V}$		
	$I_O = -200\ \mu\text{A}$	25°C	4.85	4.93	4.85	4.93			
		Full range	4.85		4.85				
	$I_O = -1\ \text{mA}$	25°C	4.25	4.65	4.25	4.65			
Full range		4.25		4.25					
$V_{OM-}$ Maximum negative peak output voltage	$V_{IC} = 0,$ $I_O = 50\ \mu\text{A}$	25°C	-4.99		-4.99		$\text{V}$		
	$V_{IC} = 0,$ $I_O = 500\ \mu\text{A}$	25°C	-4.85	-4.91	-4.85	-4.91			
		Full range	-4.85		-4.85				
	$V_{IC} = 0,$ $I_O = 5\ \text{mA}$	25°C	-3.5	-4.1	-3.5	-4.1			
Full range		-3.5		-3.5					
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 4\ \text{V}$	$R_L = 10\ \text{k}\Omega$	25°C	25	50	25	50	$\text{V}/\text{mV}$	
			Full range	25		25			
			$R_L = 1\ \text{m}\Omega$	25°C	300		300		
$r_{id}$ Differential input resistance		25°C	$10^{12}$		$10^{12}$		$\Omega$		
$r_i$ Common-mode input resistance		25°C	$10^{12}$		$10^{12}$		$\Omega$		
$c_i$ Common-mode input capacitance	$f = 10\ \text{kHz},$ P package	25°C	8		8		$\text{pF}$		
$z_o$ Closed-loop output impedance	$f = 1\ \text{MHz},$ $A_V = 10$	25°C	130		130		$\Omega$		
CMRR Common-mode rejection ratio	$V_{IC} = 0\ \text{to}\ 2.7\ \text{V},$ $V_O = 2.5\ \text{V},$ $R_S = 50\ \Omega$	25°C	75	80	75	80	dB		
		Full range	75		75				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{DD} = 4.4\ \text{V}\ \text{to}\ 16\ \text{V},$ $V_{IC} = V_{DD}/2,$ No load	25°C	80	95	80	95	dB		
		Full range	80		80				
$I_{DD}$ Supply current	$V_O = 2.5\ \text{V},$ No load	25°C	2.4	3	2.4	3	mA		
		Full range	3		3				

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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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**Advanced LinCMOS™ RAIL-TO-RAIL**  
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SLOS190 – FEBRUARY 1997

**TLC2272I operating characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS		$T_A$ †	TLC2272I			TLC2272AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = \pm 2.3\text{ V}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	2.3	3.6		2.3	3.6	V/ $\mu\text{s}$
				Full range	1.7			1.7		
$V_n$	Equivalent input noise voltage	$f = 10\text{ Hz}$	$R_L = 10\text{ k}\Omega$	25°C		50		50	nV/ $\sqrt{\text{Hz}}$	
				25°C		9		9		
$V_{NPP}$	Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to } 1\text{ Hz}$	$R_L = 10\text{ k}\Omega$	25°C		1		1	$\mu\text{V}$	
				25°C		1.4		1.4		
$I_n$	Equivalent input noise current		$R_L = 10\text{ k}\Omega$	25°C		0.6		0.6	fA/ $\sqrt{\text{Hz}}$	
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3\text{ V}$ $R_L = 10\text{ k}\Omega$ , $f = 20\text{ kHz}$	$R_L = 10\text{ k}\Omega$	25°C	$A_V = 1$	0.0011%		0.0011%		
					$A_V = 10$	0.004%		0.004%		
					$A_V = 100$	0.03%		0.03%		
	Gain-bandwidth product	$f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C		2.25		2.25	MHz	
BOM	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6\text{ V}$ , $R_L = 10\text{ k}\Omega$	$A_V = 1$ , $C_L = 100\text{ pF}$	25°C		0.54		0.54	MHz	
$t_s$	Settling time	$A_V = -1$ , Step = $-2.3\text{ V to } 2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	To 0.1%		1.5		1.5	$\mu\text{s}$
					To 0.01%		3.2		3.2	
$\phi_m$	Phase margin at unity gain	$R_L = 10\text{ k}\Omega$	$C_L = 100\text{ pF}$	25°C		52°		52°		
	Gain margin			25°C		10		10		dB

† Full range is  $-40^\circ\text{C to } 85^\circ\text{C}$ .



**TLC2274I electrical characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274I			TLC2274AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{DD\pm} = \pm 2.5\text{ V}$ , $V_{IC} = 0$ , $V_O = 0$ , $R_S = 50\ \Omega$	25°C	300	2500		300	950	$\mu\text{V}$	
		Full range			3000		1500		
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 85°C		2			2	$\mu\text{V}/^\circ\text{C}$	
Input offset voltage long-term drift (see Note 4)		25°C		0.002			0.002	$\mu\text{V}/\text{mo}$	
$I_{IO}$ Input offset current		25°C		0.5			0.5	$\text{pA}$	
		Full range			150		150		
$I_{IB}$ Input bias current	25°C		1			1	$\text{pA}$		
	Full range			150		150			
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$ , $ V_{IO}  \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2	V	
		Full range	0 to 3.5			0 to 3.5			
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C		4.99			4.99	V	
	$I_{OH} = -200\ \mu\text{A}$	25°C	4.85	4.93		4.85	4.93		
		Full range	4.85			4.85			
	$I_{OH} = -1\text{ mA}$	25°C	4.25	4.65		4.25	4.65		
Full range		4.25			4.25				
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 50\ \mu\text{A}$	25°C		0.01			0.01	V	
		25°C	0.09	0.15		0.09	0.15		
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 500\ \mu\text{A}$	Full range		0.15			0.15		
		$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 5\text{ mA}$	25°C	0.9	1.5		0.9		1.5
Full range			1.5			1.5			
$A_{VD}$ 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	15	35		15	35	V/mV
			Full range	15			15		
		$R_L = 1\text{ M}\Omega$ ‡	25°C		175			175	
$r_{id}$ Differential input resistance		25°C		$10^{12}$			$10^{12}$	$\Omega$	
$r_i$ Common-mode input resistance		25°C		$10^{12}$			$10^{12}$	$\Omega$	
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz}$ , N package	25°C		8			8	pF	
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz}$ , $A_V = 10$	25°C		140			140	$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V}$ , $V_O = 2.5\text{ V}$ , $R_S = 50\ \Omega$	25°C	70	75		70	75	dB	
		Full range	70			70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }16\text{ V}$ , $V_{IC} = V_{DD}/2$ , No load	25°C	80	95		80	95	dB	
		Full range	80			80			
$I_{DD}$ Supply current	$V_O = 2.5\text{ V}$ , No load	25°C	4.4	6		4.4	6	mA	
		Full range		6			6		

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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.

**TLC227x, TLC227xA, TLC227xY**  
**Advanced LinCMOS™ RAIL-TO-RAIL**  
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**TLC2274I operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274I			TLC2274AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR	Slew rate at unity gain $V_O = 0.5\text{ V to }2.5\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.3	3.6		2.3	3.6		V/ $\mu$ s	
		Full range	1.7			1.7				
$V_n$	Equivalent input noise voltage	f = 10 Hz	50			50			nV/ $\sqrt{\text{Hz}}$	
		f = 1 kHz	9			9				
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz	1			1			$\mu$ V	
		f = 0.1 Hz to 10 Hz	1.4			1.4				
$I_n$	Equivalent input noise current	25°C	0.6			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 = 20 kHz, $R_L = 10\text{ k}\Omega$ ‡	$A_V = 1$	0.0013%			0.0013%				
		$A_V = 10$	0.004%			0.004%				
		$A_V = 100$	0.03%			0.03%				
	Gain-bandwidth product	f = 10 kHz, $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.18			2.18			MHz
BOM	Maximum output-swing bandwidth	$V_{O(PP)} = 2\text{ V}$ , $A_V = 1$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	1			1			MHz
$t_s$	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%	1.5			1.5			$\mu$ s
			To 0.01%	2.6			2.6			
$\phi_m$	Phase margin at unity gain	$R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	50°			50°			
	Gain margin		25°C	10			10			

† Full range is – 40°C to 85°C.

‡ Referenced to 2.5 V



**TLC2274I electrical characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	T <sub>A</sub> †	TLC2274I			TLC2274AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>IO</sub> Input offset voltage	V <sub>IC</sub> = 0, V <sub>O</sub> = 0, R <sub>S</sub> = 50 Ω	25°C	300	2500		300	950	μV	
		Full range			3000		1500		
α <sub>VIO</sub> Temperature coefficient of input offset voltage		25°C to 85°C	2			2		μV/°C	
Input offset voltage long-term drift (see Note 4)		25°C	0.002			0.002		μV/mo	
I <sub>IO</sub> Input offset current		25°C	0.5			0.5		pA	
		Full range			150		150		
I <sub>IB</sub> Input bias current	25°C	1			1		pA		
	Full range			150		150			
V <sub>ICR</sub> Common-mode input voltage range	R <sub>S</sub> = 50 Ω,  V <sub>IO</sub>   ≤ 5 mV	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2	V	
		Full range	-5 to 3.5			-5 to 3.5			
V <sub>OM+</sub> Maximum positive peak output voltage	I <sub>O</sub> = -20 μA	25°C		4.99			4.99	V	
	I <sub>O</sub> = -200 μA	25°C	4.85	4.93		4.85	4.93		
		Full range	4.85			4.85			
	I <sub>O</sub> = -1 mA	25°C	4.25	4.65		4.25	4.65		
Full range		4.25			4.25				
V <sub>OM-</sub> Maximum negative peak output voltage	V <sub>IC</sub> = 0, I <sub>O</sub> = 50 μA	25°C		-4.99			-4.99	V	
		Full range	-4.85			-4.85			
	V <sub>IC</sub> = 0, I <sub>O</sub> = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
		Full range	-4.85			-4.85			
V <sub>IC</sub> = 0, I <sub>O</sub> = 5 mA	25°C	-3.5	-4.1		-3.5	-4.1			
	Full range	-3.5			-3.5				
A <sub>VD</sub> Large-signal differential voltage amplification	V <sub>O</sub> = ±4 V	R <sub>L</sub> = 10 kΩ	25°C	25	50		25	50	V/mV
			Full range	25			25		
		R <sub>L</sub> = 1 MΩ	25°C		300			300	
r <sub>id</sub> Differential input resistance		25°C		10 <sup>12</sup>			10 <sup>12</sup>	Ω	
r <sub>i</sub> Common-mode input resistance		25°C		10 <sup>12</sup>			10 <sup>12</sup>	Ω	
c <sub>i</sub> Common-mode input capacitance	f = 10 kHz, N package	25°C		8			8	pF	
z <sub>o</sub> Closed-loop output impedance	f = 1 MHz, A <sub>V</sub> = 10	25°C		130			130	Ω	
CMRR Common-mode rejection ratio	V <sub>IC</sub> = -5 to 2.7 V, V <sub>O</sub> = 0, R <sub>S</sub> = 50 Ω	25°C	75	80		75	80	dB	
		Full range	75			75			
k <sub>SVR</sub> Supply-voltage rejection ratio (ΔV <sub>DD±</sub> /ΔV <sub>IO</sub> )	V <sub>DD±</sub> = ±2.2 V to ±8 V, V <sub>IC</sub> = 0, No load	25°C	80	95		80	95	dB	
		Full range	80			80			
I <sub>DD</sub> Supply current	V <sub>O</sub> = 0, No load	25°C	4.8	6		4.8	6	mA	
		Full range			6		6		

† Full range is -40°C to 85°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T<sub>A</sub> = 150°C extrapolated to T<sub>A</sub> = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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**TLC2274I operating characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS		$T_A$ †	TLC2274I			TLC2274AI			UNIT	
				MIN	TYP	MAX	MIN	TYP	MAX		
SR	Slew rate at unity gain	$V_O = \pm 2.3\text{ V}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	2.3	3.6		2.3	3.6	V/ $\mu\text{s}$	
				Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage			25°C	50			50			nV/ $\sqrt{\text{Hz}}$
				$f = 1\text{ kHz}$	9			9			
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage			25°C	1			1			$\mu\text{V}$
				$f = 0.1\text{ Hz to }10\text{ Hz}$	1.4			1.4			
$I_n$	Equivalent input noise current			25°C	0.6			0.6			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $f = 20\text{ kHz}$		25°C	$A_V = 1$			0.0011%			
					$A_V = 10$			0.004%			
					$A_V = 100$			0.03%			
	Gain-bandwidth product	$f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	2.25			2.25			MHz
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6\text{ V}$ , $R_L = 10\text{ k}\Omega$	$A_V = 1$ , $C_L = 100\text{ pF}$	25°C	0.54			0.54			MHz
$t_s$	Settling time	$A_V = -1$ , Step = $-2.3\text{ V to }2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 0.1%	25°C	1.5			1.5			$\mu\text{s}$
			To 0.01%		3.2			3.2			
$\phi_m$	Phase margin at unity gain	$R_L = 10\text{ k}\Omega$	$C_L = 100\text{ pF}$	25°C	52°			52°			
	Gain margin			25°C	10			10			

† Full range is  $-40^\circ\text{C to }85^\circ\text{C}$ .



TLC2272M electrical characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272M			TLC2272AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage		25°C		300	2500		300	950	$\mu\text{V}$
		Full range			3000			1500	
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 125°C		2			2	$\mu\text{V}/^\circ\text{C}$	
Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0,$ $V_O = 0,$	25°C		0.002			0.00 2	$\mu\text{V}/\text{mo}$	
$I_{IO}$ Input offset current		25°C		0.5			0.5	$\text{pA}$	
		Full range			500				500
$I_{IB}$ Input bias current		25°C		1			1	$\text{pA}$	
		Full range			500				500
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega,$ $ V_{IO}  \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2	$\text{V}$	
		Full range	0 to 3.5			0 to 3.5			
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$ $I_{OH} = -200\ \mu\text{A}$ $I_{OH} = -1\ \text{mA}$	25°C				4.99		$\text{V}$	
		25°C				4.85	4.93		
		Full range				4.85			
		25°C				4.25	4.65		
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\ \text{V},$ $I_{OL} = 50\ \mu\text{A}$ $V_{IC} = 2.5\ \text{V},$ $I_{OL} = 500\ \mu\text{A}$ $V_{IC} = 2.5\ \text{V},$ $I_{OL} = 5\ \text{mA}$	25°C				0.01		$\text{V}$	
		25°C				0.09	0.15		
		Full range					0.15		0.15
		25°C				0.9	1.5		
$A_{VD}$ Large-signal differential voltage amplification	$V_{IC} = 2.5\ \text{V},$ $V_O = 1\ \text{V to } 4\ \text{V}$	25°C				10	35	10	35
						Full range	10		10
		25°C				175		175	$\text{V}/\text{mV}$
$r_{id}$ Differential input resistance		25°C				$10^{12}$		$\Omega$	
$r_i$ Common-mode input resistance		25°C				$10^{12}$		$\Omega$	
$c_i$ Common-mode input capacitance	$f = 10\ \text{kHz},$ P package	25°C				8		$\text{pF}$	
$z_o$ Closed-loop output impedance	$f = 1\ \text{MHz},$ $A_V = 10$	25°C				140		$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = 0\ \text{to } 2.7\ \text{V},$ $V_O = 2.5\ \text{V},$ $R_S = 50\ \Omega$	25°C				70	75	$\text{dB}$	
		Full range				70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\ \text{V to } 16\ \text{V},$ $V_{IC} = V_{DD}/2,$ No load	25°C				80	95	$\text{dB}$	
		Full range				80			
$I_{DD}$ Supply current	$V_O = 2.5\ \text{V},$ No load	25°C				2.2	3	$\text{mA}$	
		Full range					3		

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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.

**TLC227x, TLC227xA, TLC227xY**  
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**TLC2272M operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2272M			TLC2272AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR	Slew rate at unity gain $V_O = 0.5\text{ V to }2.5\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.3	3.6		2.3	3.6	V/ $\mu\text{s}$		
		Full range	1.7			1.7				
$V_n$	Equivalent input noise voltage $f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C		50			50	nV/ $\sqrt{\text{Hz}}$		
		25°C		9			9			
$V_{NPP}$	Peak-to-peak equivalent input noise voltage $f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$	25°C		1			1	$\mu\text{V}$		
		25°C		1.4			1.4			
$I_n$	Equivalent input noise current	25°C		0.6			0.6	fA/ $\sqrt{\text{Hz}}$		
THD + N	Total harmonic distortion plus noise $V_O = 0.5\text{ V to }2.5\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega$ ‡,	25°C		$A_V = 1$		0.0013%		0.0013%		
				$A_V = 10$		0.004%		0.004%		
				$A_V = 100$		0.03%		0.03%		
	Gain-bandwidth product $f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$ ‡	25°C			2.18			2.18	MHz	
BOM	Maximum output-swing bandwidth $V_{O(PP)} = 2\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡,	25°C			1			1	MHz	
$t_s$	Settling time $A_V = -1$ , Step = 0.5 V to 2.5 V, $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C		To 0.1%		1.5			1.5	$\mu\text{s}$
				To 0.01%		2.6			2.6	
$\phi_m$	Phase margin at unity gain $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C			50°			50°		
		25°C			10			10	dB	

† Full range is –55°C to 125°C.

‡ Referenced to 2.5 V





TLC2272M electrical characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T <sub>A</sub> †	TLC2272M			TLC2272AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
V <sub>IO</sub> Input offset voltage	V <sub>IC</sub> = 0, V <sub>O</sub> = 0, R <sub>S</sub> = 50 Ω	25°C	300		2500	300		950	μV	
		Full range	3000			1500				
α <sub>VIO</sub> Temperature coefficient of input offset voltage		25°C to 125°C	2			2			μV/°C	
Input offset voltage long-term drift (see Note 4)		25°C	0.002			0.002			μV/mo	
I <sub>IO</sub> Input offset current		25°C	0.5			0.5			pA	
		Full range	500			500				
I <sub>IB</sub> Input bias current	25°C	1			1			pA		
	Full range	500			500					
V <sub>ICR</sub> Common-mode input voltage range	R <sub>S</sub> = 50 Ω,  V <sub>IO</sub>   ≤ 5 mV	25°C	-5 to 4	-5.3 to 4.2	-5 to 4	-5.3 to 4.2			V	
		Full range	-5 to 3.5		-5 to 3.5					
V <sub>OM+</sub> Maximum positive peak output voltage	I <sub>O</sub> = -20 μA	25°C	4.99		4.99				V	
	I <sub>O</sub> = -200 μA	25°C	4.85	4.93	4.85	4.93				
		Full range	4.85		4.85					
	I <sub>O</sub> = -1 mA	25°C	4.25	4.65	4.25	4.65				
Full range		4.25		4.25						
V <sub>OM-</sub> Maximum negative peak output voltage	V <sub>IC</sub> = 0, I <sub>O</sub> = 50 μA	25°C	-4.99		-4.99				V	
		25°C	-4.85	-4.91	-4.85	-4.91				
	V <sub>IC</sub> = 0, I <sub>O</sub> = 500 μA	Full range	-4.85		-4.85					
		V <sub>IC</sub> = 0, I <sub>O</sub> = 5 mA	25°C	-3.5	-4.1	-3.5	-4.1			
Full range	-3.5		-3.5							
A <sub>VD</sub> Large-signal differential voltage amplification	V <sub>O</sub> = ±4 V	R <sub>L</sub> = 10 kΩ	25°C	20	50	20	50			V/mV
			Full range	20		20				
		R <sub>L</sub> = 1 mΩ	25°C	300		300				
r <sub>id</sub> Differential input resistance		25°C	10 <sup>12</sup>			10 <sup>12</sup>		Ω		
r <sub>i</sub> Common-mode input resistance		25°C	10 <sup>12</sup>			10 <sup>12</sup>		Ω		
c <sub>i</sub> Common-mode input capacitance	f = 10 kHz, P package	25°C	8			8		pF		
z <sub>o</sub> Closed-loop output impedance	f = 1 MHz, A <sub>v</sub> = 10	25°C	130			130		Ω		
CMRR Common-mode rejection ratio	V <sub>IC</sub> = 0 to 2.7 V, V <sub>O</sub> = 2.5 V, R <sub>S</sub> = 50 Ω	25°C	75	80	75	80			dB	
		Full range	75		75					
k <sub>SVR</sub> Supply-voltage rejection ratio (ΔV <sub>DD±</sub> /ΔV <sub>IO</sub> )	V <sub>DD</sub> = 4.4 V to 16 V, V <sub>IC</sub> = 0, No load	25°C	80	95	80	95			dB	
		Full range	80		80					
I <sub>DD</sub> Supply current	V <sub>O</sub> = 2.5 V, No load	25°C	2.4	3	2.4	3			mA	
		Full range	3		3					

† Full range is -55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T<sub>A</sub> = 150°C extrapolated to T<sub>A</sub> = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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**TLC2272M operating characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS		$T_A$ †	TLC2272M			TLC2272AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = \pm 2.3\text{ V}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	2.3	3.6		2.3	3.6	V/ $\mu$ s
				Full range	1.7			1.7		
$V_n$	Equivalent input noise voltage	$f = 10\text{ Hz}$	$R_L = 10\text{ k}\Omega$	25°C		50		50	nV/ $\sqrt{\text{Hz}}$	
				$f = 1\text{ kHz}$		9		9		
$V_{NPP}$	Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$	$R_L = 10\text{ k}\Omega$	25°C		1		1	$\mu$ V	
				$f = 0.1\text{ Hz to }10\text{ Hz}$		1.4		1.4		
$I_n$	Equivalent input noise current		$R_L = 10\text{ k}\Omega$	25°C		0.6		0.6	fA/ $\sqrt{\text{Hz}}$	
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3\text{ V}$ $R_L = 10\text{ k}\Omega$ , $f = 20\text{ kHz}$	$R_L = 10\text{ k}\Omega$	25°C	$A_V = 1$	0.0011%		0.0011%		
					$A_V = 10$	0.004%		0.004%		
					$A_V = 100$	0.03%		0.03%		
	Gain-bandwidth product	$f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C		2.25		2.25	MHz	
BOM	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6\text{ V}$ , $R_L = 10\text{ k}\Omega$	$A_V = 1$ , $C_L = 100\text{ pF}$	25°C		0.54		0.54	MHz	
$t_s$	Settling time	$A_V = -1$ , Step = $-2.3\text{ V to }2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	$R_L = 10\text{ k}\Omega$	25°C	To 0.1%	1.5		1.5	$\mu$ s	
					To 0.01%	3.2		3.2		
$\phi_m$	Phase margin at unity gain	$R_L = 10\text{ k}\Omega$	$C_L = 100\text{ pF}$	25°C		52°		52°		
	Gain margin			25°C		10		10		dB

† Full range is  $-55^\circ\text{C to }125^\circ\text{C}$ .



**TLC2274M electrical characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274M			TLC2274AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage		25°C	300	2500		300	950	$\mu\text{V}$	
		Full range	3000			1500			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		25°C to 125°C	2			2			$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)	$V_{DD\pm} = \pm 2.5\text{ V}$ , $V_O = 0$ , $V_{IC} = 0$ , $R_S = 50\ \Omega$	25°C	0.002			0.002			$\mu\text{V}/\text{mo}$
$I_{IO}$ Input offset current		25°C	0.5			0.5			$\text{pA}$
		Full range	500			500			
$I_{IB}$ Input bias current		25°C	1			1			$\text{pA}$
		Full range	500			500			
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$ , $ V_{IO}  \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2	$\text{V}$	
		Full range	0 to 3.5			0 to 3.5			
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C	4.99			4.99			$\text{V}$
		25°C	4.85	4.93		4.85	4.93		
		Full range	4.85			4.85			
		25°C	4.25	4.65		4.25	4.65		
$I_{OH} = -1\text{ mA}$		25°C	4.25	4.65		4.25	4.65	$\text{V}$	
		Full range	4.25			4.25			
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 50\ \mu\text{A}$	25°C	0.01			0.01			$\text{V}$
		25°C	0.09	0.15		0.09	0.15		
	Full range	0.15			0.15				
	25°C	0.9	1.5		0.9	1.5			
$I_{OL} = 5\text{ mA}$		25°C	0.9	1.5		0.9	1.5	$\text{V}$	
		Full range	1.5			1.5			
$A_{VD}$ 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	10	35		10	35	$\text{V/mV}$
			Full range	10			10		
		$R_L = 1\text{ M}\Omega$ ‡	25°C	175			175		
$r_{id}$ Differential input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$r_i$ Common-mode input resistance		25°C	$10^{12}$			$10^{12}$			$\Omega$
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz}$ , N package	25°C	8			8			$\text{pF}$
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz}$ , $A_V = 10$	25°C	140			140			$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V}$ , $V_O = 2.5\text{ V}$ , $R_S = 50\ \Omega$	25°C	70	75		70	75	dB	
		Full range	70			70			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }16$ , $V_{IC} = V_{DD}/2$ , No load	25°C	80	95		80	95	dB	
		Full range	80			80			
$I_{DD}$ Supply current	$V_O = 2.5\text{ V}$ , No load	25°C	4.4	6		4.4	6	mA	
		Full range	6			6			

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

‡ Referenced to 2.5 V

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 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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**TLC2274M operating characteristics at specified free-air temperature,  $V_{DD} = 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274M			TLC2274AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain $V_O = 0.5\text{ V to }2.5\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	2.3	3.6		2.3	3.6		V/ $\mu\text{s}$
		Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage $f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C	50			50			nV/ $\sqrt{\text{Hz}}$
		25°C	9			9			
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage $f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$	25°C	1			1			$\mu\text{V}$
		25°C	1.4			1.4			
$I_n$	Equivalent input noise current	25°C	0.6			0.6			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise $V_O = 0.5\text{ V to }2.5\text{ V}$ , $f = 20\text{ kHz}$ , $R_L = 10\text{ k}\Omega$ ‡	25°C	$A_V = 1$			0.0013%			
			$A_V = 10$			0.004%			
			$A_V = 100$			0.03%			
	Gain-bandwidth product $f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$ ‡	25°C	2.18			2.18			MHz
$B_{OM}$	Maximum output-swinging bandwidth $V_{O(PP)} = 2\text{ V}$ , $R_L = 10\text{ k}\Omega$ ‡, $A_V = 1$ , $C_L = 100\text{ pF}$ ‡	25°C	1			1			MHz
$t_s$	Settling time $A_V = -1$ , Step = 0.5 V to 2.5 V, $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	To 0.1%			1.5			$\mu\text{s}$
			To 0.01%			2.6			
$\phi_m$	Phase margin at unity gain $R_L = 10\text{ k}\Omega$ ‡, $C_L = 100\text{ pF}$ ‡	25°C	50°			50°			
		25°C	10			10			
	Gain margin	25°C	10			10			dB

† Full range is – 55°C to 125°C.

‡ Referenced to 2.5 V



TLC2274M electrical characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T <sub>A</sub> †	TLC2274M			TLC2274AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>IO</sub> Input offset voltage	V <sub>IC</sub> = 0, V <sub>O</sub> = 0, R <sub>S</sub> = 50 Ω	25°C	300	2500		300	950	μV	
		Full range			3000		1500		
α <sub>VIO</sub> Temperature coefficient of input offset voltage		25°C to 125°C	2			2		μV/°C	
Input offset voltage long-term drift (see Note 4)		25°C	0.002			0.002		μV/mo	
I <sub>IO</sub> Input offset current		25°C	0.5			0.5		pA	
		Full range			500		500		
I <sub>IB</sub> Input bias current		25°C	1			1		pA	
		Full range			500		500		
V <sub>ICR</sub> Common-mode input voltage range	R <sub>S</sub> = 50 Ω,  V <sub>IO</sub>   ≤ 5 mV	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2	V	
		Full range	-5 to 3.5			-5 to 3.5			
V <sub>OM+</sub> Maximum positive peak output voltage	I <sub>O</sub> = -20 μA	25°C		4.99			4.99	V	
	I <sub>O</sub> = -200 μA	25°C	4.85	4.93		4.85	4.93		
		Full range	4.85			4.85			
	I <sub>O</sub> = -1 mA	25°C	4.25	4.65		4.25	4.65		
Full range		4.25			4.25				
V <sub>OM-</sub> Maximum negative peak output voltage	V <sub>IC</sub> = 0, I <sub>O</sub> = 50 μA	25°C		-4.99			-4.99	V	
	V <sub>IC</sub> = 0, I <sub>O</sub> = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
		Full range	-4.85			-4.85			
	V <sub>IC</sub> = 0, I <sub>O</sub> = 5 mA	25°C	-3.5	-4.1		-3.5	-4.1		
Full range		-3.5			-3.5				
A <sub>VD</sub> Large-signal differential voltage amplification	V <sub>O</sub> = ±4 V	R <sub>L</sub> = 10 kΩ	25°C	20	50		20	50	V/mV
			Full range	20			20		
		R <sub>L</sub> = 1 MΩ	25°C		300			300	
r <sub>id</sub> Differential input resistance		25°C		10 <sup>12</sup>			10 <sup>12</sup>	Ω	
r <sub>i</sub> Common-mode input resistance		25°C		10 <sup>12</sup>			10 <sup>12</sup>	Ω	
c <sub>i</sub> Common-mode input capacitance	f = 10 kHz, N package	25°C		8			8	pF	
z <sub>o</sub> Closed-loop output impedance	f = 1 MHz, A <sub>V</sub> = 10	25°C		130			130	Ω	
CMRR Common-mode rejection ratio	V <sub>IC</sub> = -5 V to 2.7 V V <sub>O</sub> = 0, R <sub>S</sub> = 50 Ω	25°C	75	80		75	80	dB	
		Full range	75			75			
k <sub>SVR</sub> Supply-voltage rejection ratio (ΔV <sub>DD±</sub> /ΔV <sub>IO</sub> )	V <sub>DD±</sub> = ± 2.2 V to ± 8 V, V <sub>IC</sub> = 0, No load	25°C	80	95		80	95	dB	
		Full range	80			80			
I <sub>DD</sub> Supply current	V <sub>O</sub> = 0, No load	25°C		4.8	6		4.8	6	mA
		Full range			6		6		

† Full range is -55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at T<sub>A</sub> = 150°C extrapolated to T<sub>A</sub> = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

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**TLC2274M operating characteristics at specified free-air temperature,  $V_{DD\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLC2274M			TLC2274AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain $V_O = \pm 2.3\text{ V}$ , $C_L = 100\text{ pF}$ , $R_L = 10\text{ k}\Omega$	25°C	2.3	3.6		2.3	3.6		V/ $\mu$ s
		Full range	1.7			1.7			
$V_n$	Equivalent input noise voltage $f = 10\text{ Hz}$ $f = 1\text{ kHz}$	25°C	50			50			nV/ $\sqrt{\text{Hz}}$
		25°C	9			9			
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage $f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$	25°C	1			1			$\mu$ V
		25°C	1.4			1.4			
$I_n$	Equivalent input noise current	25°C	0.6			0.6			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise $V_O = \pm 2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $f = 20\text{ kHz}$	$A_V = 1$	0.0011%			0.0011%			
		$A_V = 10$	0.004%			0.004%			
		$A_V = 100$	0.03%			0.03%			
	Gain-bandwidth product $f = 10\text{ kHz}$ , $C_L = 100\text{ pF}$ , $R_L = 10\text{ k}\Omega$	25°C	2.25			2.25			MHz
BOM	Maximum output-swing bandwidth $V_{O(PP)} = 4.6\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $A_V = 1$ , $C_L = 100\text{ pF}$	25°C	0.54			0.54			MHz
$t_s$	Settling time $A_V = -1$ , Step = $-2.3\text{ V to }2.3\text{ V}$ , $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 0.1%	1.5			1.5			$\mu$ s
		To 0.01%	3.2			3.2			
$\phi_m$	Phase margin at unit gain $R_L = 10\text{ k}\Omega$ , $C_L = 100\text{ pF}$	25°C	52°			52°			
		25°C	10			10			dB

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .



**TLC2272Y electrical characteristics at  $V_{DD} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	TLC2274Y			UNIT
			MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$V_{IC} = 0,$ $V_O = 0,$ $V_{DD\pm} = \pm 2.5\text{ V},$ $R_S = 50\ \Omega$	300	2500		$\mu\text{V}$
$I_{IO}$	Input offset current		0.5	100		$\text{pA}$
$I_{IB}$	Input bias current		1	100		$\text{pA}$
$V_{ICR}$	Common-mode input voltage range	$R_S = 50\ \Omega$	0 to 4	-0.3 to 4.2		V
$V_{OH}$	High-level output voltage	$ V_{IO}  \leq 5\text{ mV}$ $I_{OH} = -20\ \mu\text{A}$ $I_{OH} = -200\ \mu\text{A}$	4.99		V	
			4.85 4.93			
			4.25 4.65			
$V_{OL}$	Low-level output voltage	$I_{OL} = -1\text{ mA}$ $V_{IC} = 2.5\text{ V}, I_{OL} = 50\ \mu\text{A}$ $V_{IC} = 2.5\text{ V}, I_{OL} = 500\ \mu\text{A}$	0.01		V	
			0.09 0.15			
			0.9 1.5			
$A_{VD}$	Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V},$ $I_{OL} = 5\text{ mA}$	$R_L = 10\text{ k}\Omega^\dagger$	15	35	V/mV
			$R_L = 1\text{ M}\Omega^\dagger$	175		
$r_{id}$	Differential input resistance	$V_O = 1\text{ V to }4\text{ V}$	$10^{12}$		$\Omega$	
$r_i$	Common-mode input resistance		$10^{12}$		$\Omega$	
$c_i$	Common-mode input capacitance	$f = 10\text{ kHz}$	8		$\text{pF}$	
$z_o$	Closed-loop output impedance	$f = 1\text{ MHz}, A_V = 10$	140		$\Omega$	
CMRR	Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V},$ $R_S = 50\ \Omega$	$V_O = 2.5\text{ V},$	70	75	dB
kSVR	Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }16\text{ V},$ No load	$V_{IC} = V_{DD}/2,$	80	95	dB
$I_{DD}$	Supply current	$V_O = 2.5\text{ V},$ No load	4.4	6	mA	

$^\dagger$  Referenced to 2.5 V

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**TLC2272Y electrical characteristics at  $V_{DD} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	TLC2272Y			UNIT
		MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0$ , $V_O = 0$ , $V_{DD\pm} = \pm 2.5\text{ V}$ , $R_S = 50\ \Omega$		300	2500	$\mu\text{V}$
$I_{IO}$ Input offset current			0.5	100	pA
$I_{IB}$ Input bias current			1	100	pA
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$ , $ V_{IO}  \leq 5\text{ mV}$	0 to 4	-0.3 to 4.2		V
$V_{OH}$ High-level output voltage	$I_{OH} = -20\ \mu\text{A}$		4.99		V
	$I_{OH} = -200\ \mu\text{A}$	4.85	4.93		
	$I_{OH} = -1\text{ mA}$	4.25	4.65		
$V_{OL}$ Low-level output voltage	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 50\ \mu\text{A}$		0.01		V
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 500\ \mu\text{A}$		0.09	0.15	
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 5\text{ mA}$		0.9	1.5	
$A_{VD}$ Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}$ , $V_O = 1\text{ V to }4\text{ V}$	$R_L = 10\text{ k}\Omega^\dagger$	15	35	V/mV
		$R_L = 1\text{ M}\Omega^\dagger$		175	
$r_{id}$ Differential input resistance			$10^{12}$		$\Omega$
$r_i$ Common-mode input resistance			$10^{12}$		$\Omega$
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz}$		8		pF
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz}$ , $A_V = 10$		140		$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to }2.7\text{ V}$ , $V_O = 2.5\text{ V}$ , $R_S = 50\ \Omega$	70	75		dB
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to }16\text{ V}$ , $V_{IC} = V_{DD}/2$ , No load	80	95		dB
$I_{DD}$ Supply current	$V_O = 2.5\text{ V}$ , No load		2.2	3	mA

$^\dagger$  Referenced to 2.5 V





**TLC2272Y electrical characteristics at  $V_{DD\pm} = \pm 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	TLC2272Y			UNIT
		MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0$ , $R_S = 50\ \Omega$ , $V_O = 0$		300	2500	$\mu\text{V}$
$I_{IO}$ Input offset current			0.5	100	$\text{pA}$
$I_{IB}$ Input bias current			1	100	$\text{pA}$
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$ , $ V_{IO}  \leq 5\text{ mV}$	-5 to 4	-5.3 to 4.2		V
$V_{OM+}$ Maximum positive peak output voltage	$I_O = -20\ \mu\text{A}$		4.99		V
	$I_O = -200\ \mu\text{A}$	4.85	4.93		
	$I_O = -1\text{ mA}$	4.25	4.65		
$V_{OM-}$ Maximum negative peak output voltage	$V_{IC} = 0$ , $I_{OL} = 50\ \mu\text{A}$		-4.99		V
	$V_{IC} = 0$ , $I_{OL} = 500\ \mu\text{A}$	-4.85	-4.91		
	$V_{IC} = 0$ , $I_{OL} = 5\text{ mA}$	-3.5	-4.1		
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 4\text{ V}$	$R_L = 10\text{ k}\Omega$	25	50	V/mV
		$R_L = 1\text{ M}\Omega$		300	
$r_{id}$ Differential input resistance			$10^{12}$		$\Omega$
$r_i$ Common-mode input resistance			$10^{12}$		$\Omega$
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz}$		8		$\text{pF}$
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz}$ , $A_V = 10$		130		$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = -5\text{ V to } 2.7\text{ V}$ , $V_O = 0$ , $R_S = 50\ \Omega$	75	80		dB
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{DD\pm} = \pm 2.2\text{ V to } \pm 8\text{ V}$ , $V_{IC} = 0$ , No load	80	95		dB
$I_{DD}$ Supply current	$V_O = 0$ , No load		2.4	3	mA

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**TLC2274Y electrical characteristics at  $V_{DD} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	TLC2274Y			UNIT
		MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0$ , $V_O = 0$ , $V_{DD\pm} = \pm 2.5\text{ V}$ , $R_S = 50\ \Omega$		300	2500	$\mu\text{V}$
$I_{IO}$ Input offset current			0.5	100	pA
$I_{IB}$ Input bias current				1	100
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	0 to 4	-0.3 to 4.2		V
$V_{OH}$ High-level output voltage	$ V_{IO}  \leq 5\text{ mV}$		4.99		V
	$I_{OH} = -20\ \mu\text{A}$		4.85	4.93	
	$I_{OH} = -200\ \mu\text{A}$		4.25	4.65	
$V_{OL}$ Low-level output voltage	$I_{OL} = -1\text{ mA}$		0.01		V
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 50\ \mu\text{A}$		0.09	0.15	
	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 500\ \mu\text{A}$		0.9	1.5	
$A_{VD}$ Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}$ , $I_{OL} = 5\text{ mA}$	$R_L = 10\text{ k}\Omega^\dagger$	15	35	V/mV
		$R_L = 1\text{ M}\Omega^\dagger$		175	
$r_{id}$ Differential input resistance	$V_O = 1\text{ V to } 4\text{ V}$		10 <sup>12</sup>		$\Omega$
$r_i$ Common-mode input resistance			10 <sup>12</sup>		$\Omega$
$c_i$ Common-mode input capacitance	$f = 10\text{ kHz}$		8		pF
$z_o$ Closed-loop output impedance	$f = 1\text{ MHz}$ , $A_V = 10$		140		$\Omega$
CMRR Common-mode rejection ratio	$V_{IC} = 0\text{ to } 2.7\text{ V}$ , $R_S = 50\ \Omega$ , $V_O = 2.5\text{ V}$		70	75	dB
kSVR Supply-voltage rejection ratio ( $\Delta V_{DD}/\Delta V_{IO}$ )	$V_{DD} = 4.4\text{ V to } 16\text{ V}$ , No load, $V_{IC} = V_{DD}/2$		80	95	dB
$I_{DD}$ Supply current	$V_O = 2.5\text{ V}$ , No load		4.4	6	mA

$^\dagger$  Referenced to 2.5 V



**TLC2274Y electrical characteristics at  $V_{DD\pm} = \pm 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	TLC2274Y			UNIT
			MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega$	$V_O = 0,$	300	2500	$\mu\text{V}$
$I_{IO}$	Input offset current			0.5	100	$\text{pA}$
$I_{IB}$	Input bias current			1	100	$\text{pA}$
$V_{ICR}$	Common-mode input voltage range	$R_S = 50\ \Omega,$	$ V_{IO}  \leq 5\ \text{mV}$	-5 to 4	-5.3 to 4.2	V
$V_{OM+}$	Maximum positive peak output voltage	$I_O = -20\ \mu\text{A}$		4.99		V
		$I_O = -200\ \mu\text{A}$		4.85	4.93	
		$I_O = -1\ \text{mA}$		4.25	4.65	
$V_{OM-}$	Maximum negative peak output voltage	$V_{IC} = 0,$	$I_{OL} = 50\ \mu\text{A}$	-4.99		V
		$V_{IC} = 0,$	$I_{OL} = 500\ \mu\text{A}$	-4.85	-4.91	
		$V_{IC} = 0,$	$I_{OL} = 5\ \text{mA}$	-3.5	-4.1	
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 4\ \text{V}$	$R_L = 10\ \text{k}\Omega$	25	50	V/mV
			$R_L = 1\ \text{M}\Omega$	300		
$r_{id}$	Differential input resistance			$10^{12}$		$\Omega$
$r_i$	Common-mode input resistance			$10^{12}$		$\Omega$
$c_i$	Common-mode input capacitance	$f = 10\ \text{kHz}$		8		$\text{pF}$
$z_o$	Closed-loop output impedance	$f = 1\ \text{MHz},$	$A_V = 10$	130		$\Omega$
CMRR	Common-mode rejection ratio	$V_{IC} = -5\ \text{V to } 2.7\ \text{V},$ $R_S = 50\ \Omega$	$V_O = 0,$	75	80	dB
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{DD\pm} = \pm 2.2\ \text{V to } \pm 8\ \text{V},$ $V_{IC} = 0$		80	95	dB
$I_{DD}$	Supply current	$V_O = 0,$	No load	4.8	6	$\text{mA}$

**TLC227x, TLC227xA, TLC227xY**  
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**TYPICAL CHARACTERISTICS**

**Table of Graphs**

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NOTE: For all graphs where  $V_{DD} = 5\text{ V}$ , all loads are referenced to 2.5 V.



TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLC2272  
 INPUT OFFSET VOLTAGE

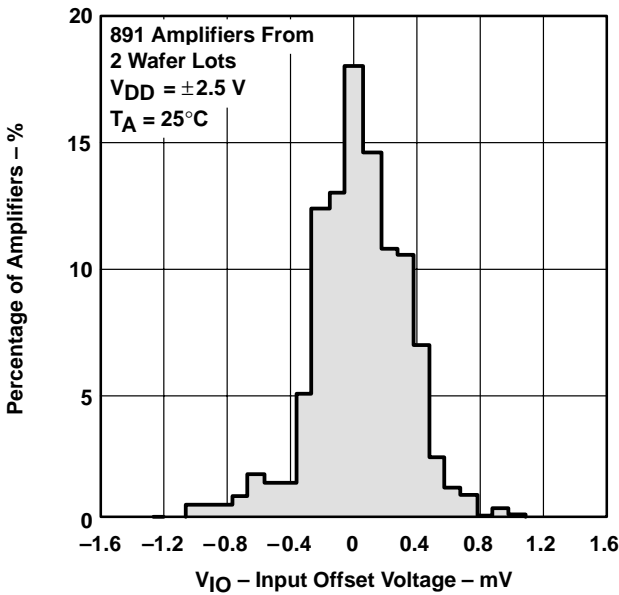


Figure 1

DISTRIBUTION OF TLC2272  
 INPUT OFFSET VOLTAGE

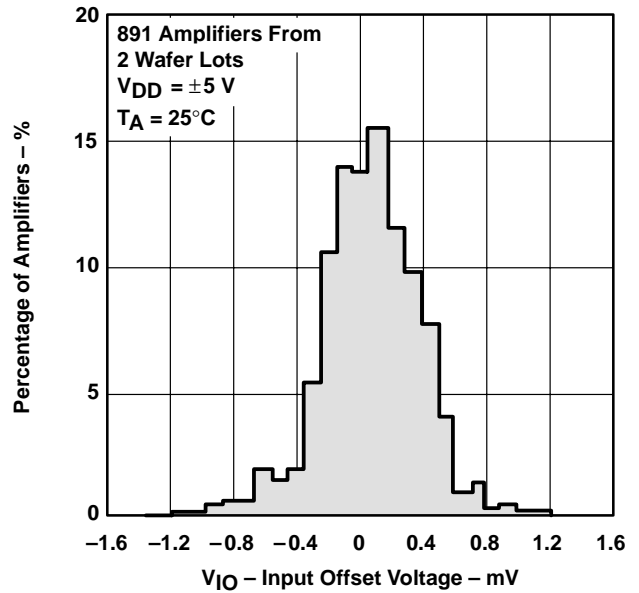


Figure 2

DISTRIBUTION OF TLC2274  
 INPUT OFFSET VOLTAGE

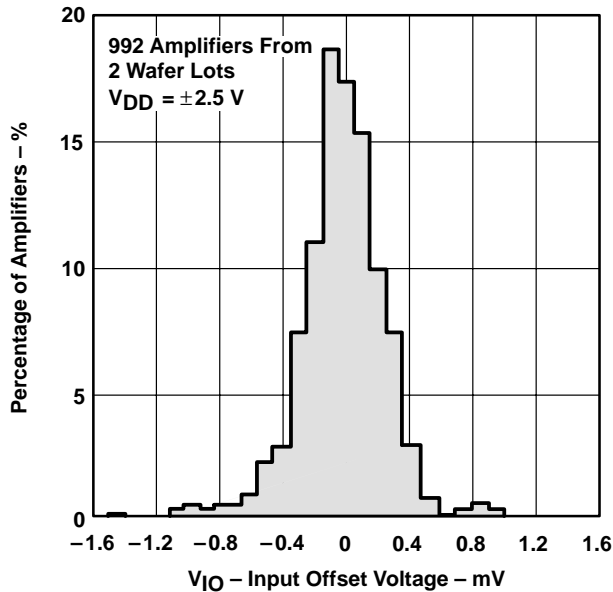


Figure 3

DISTRIBUTION OF TLC2274  
 INPUT OFFSET VOLTAGE

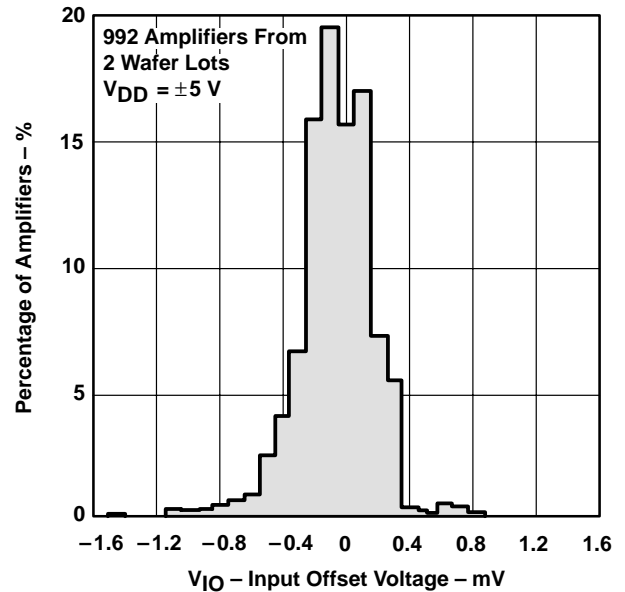


Figure 4

TYPICAL CHARACTERISTICS

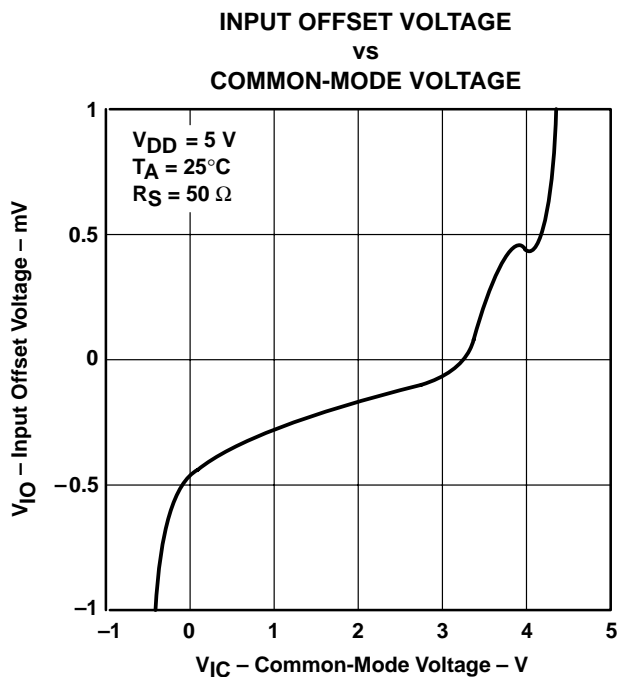


Figure 5

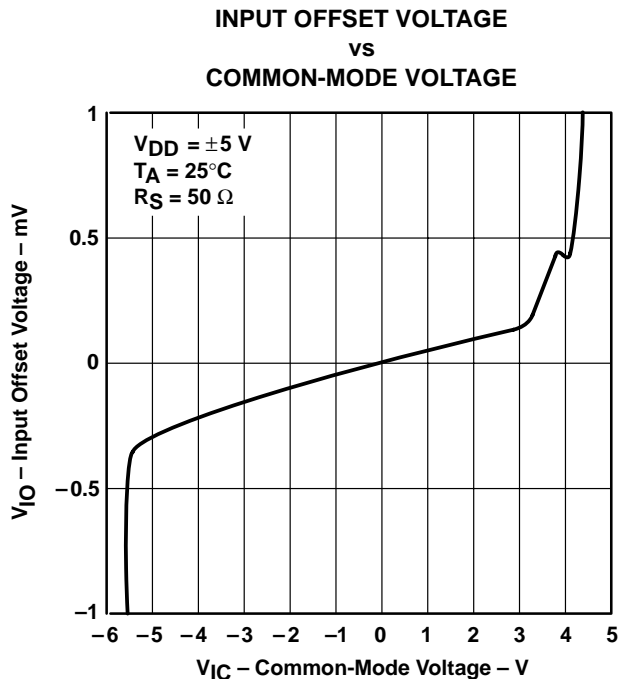


Figure 6

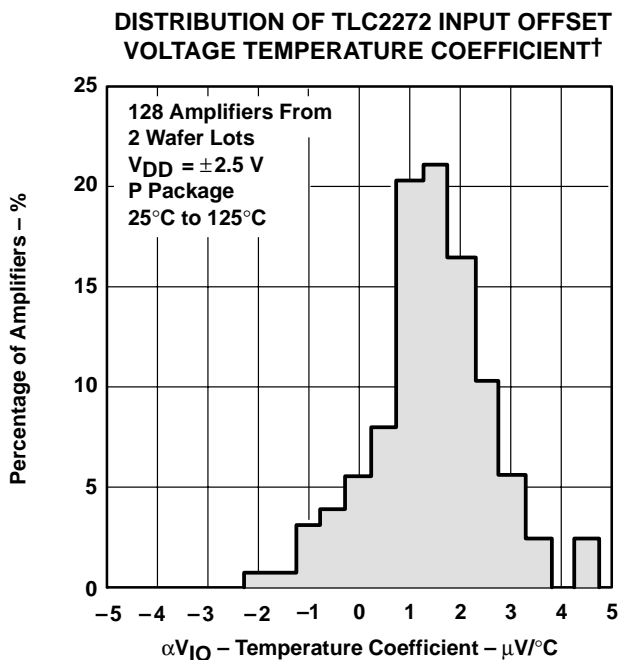


Figure 7

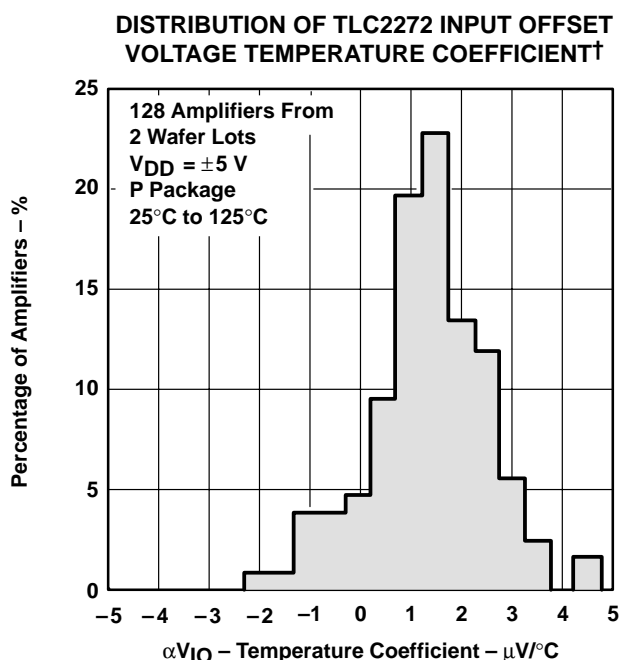


Figure 8

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

TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT†

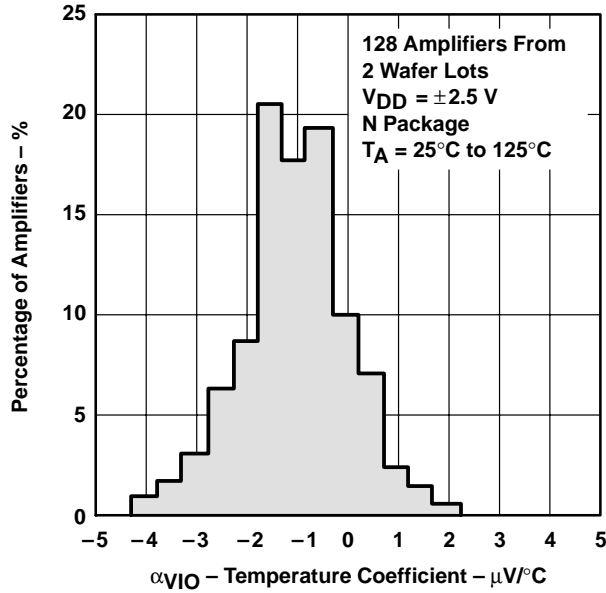


Figure 9

DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT†

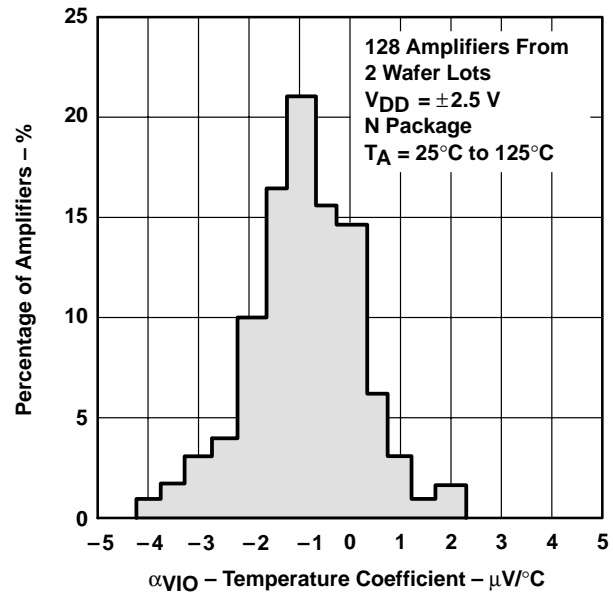


Figure 10

INPUT BIAS AND OFFSET CURRENT†  
 vs  
 FREE-AIR TEMPERATURE

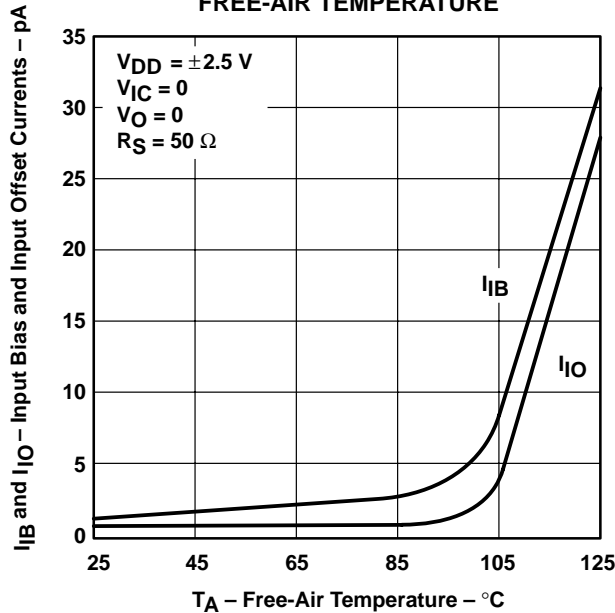


Figure 11

INPUT VOLTAGE RANGE  
 vs  
 SUPPLY VOLTAGE

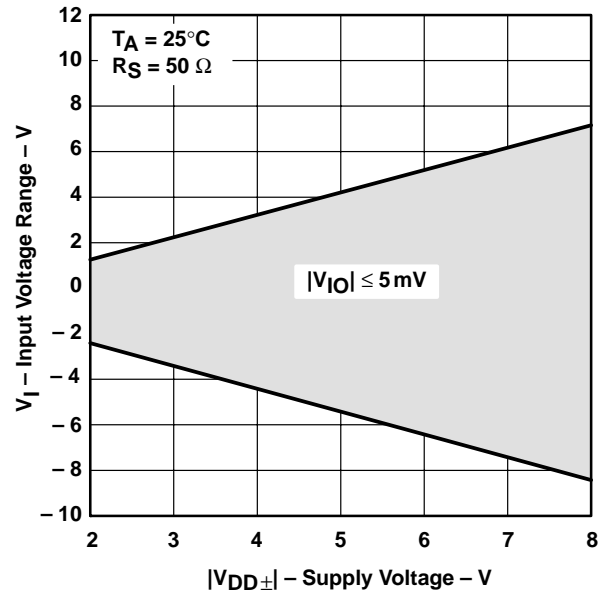


Figure 12

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

TYPICAL CHARACTERISTICS

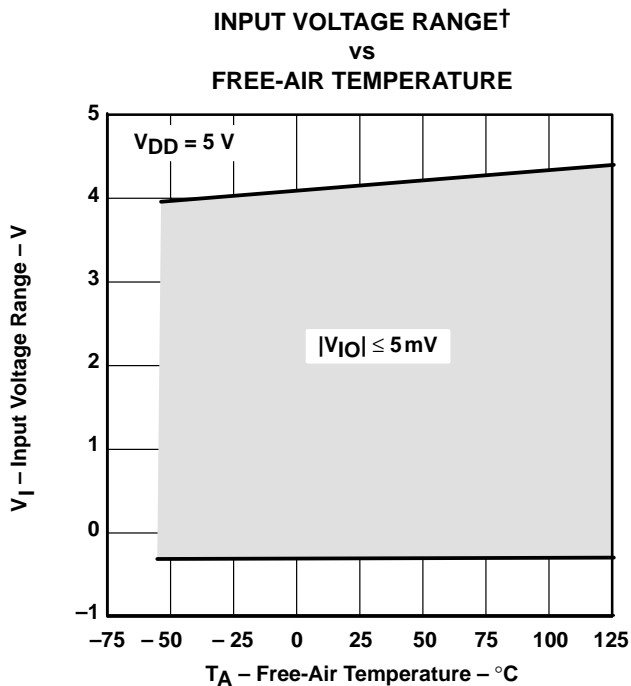


Figure 13

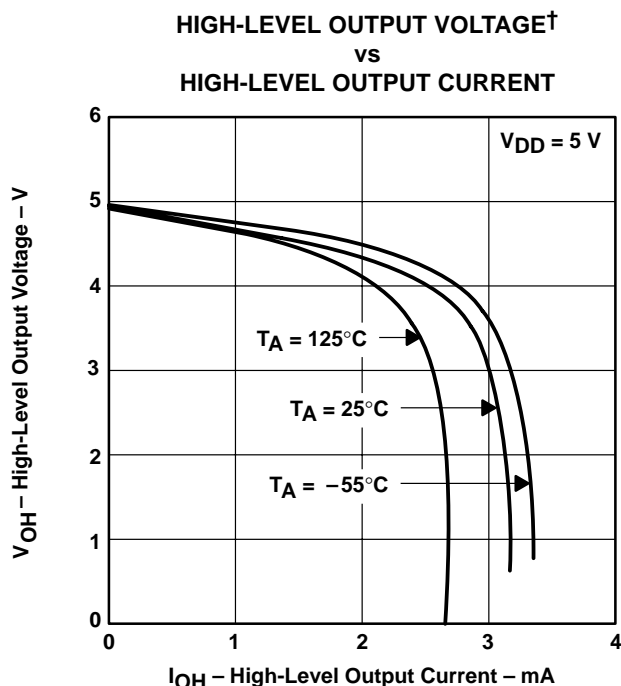


Figure 14

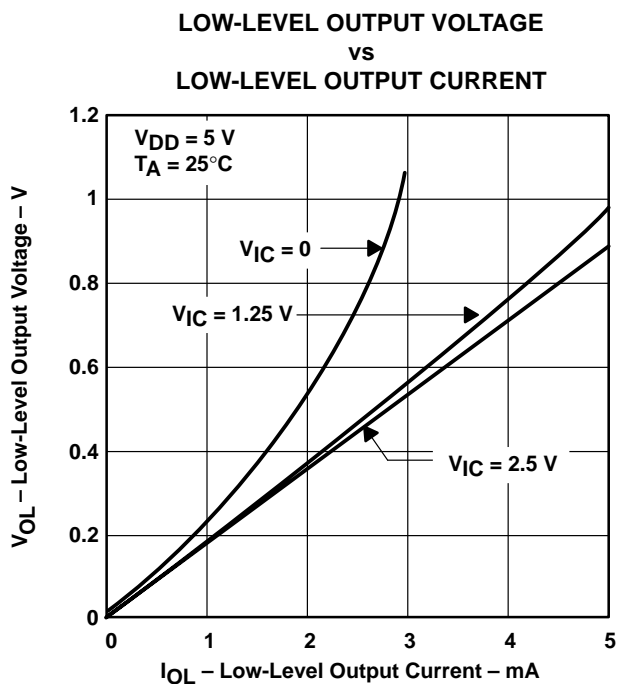


Figure 15

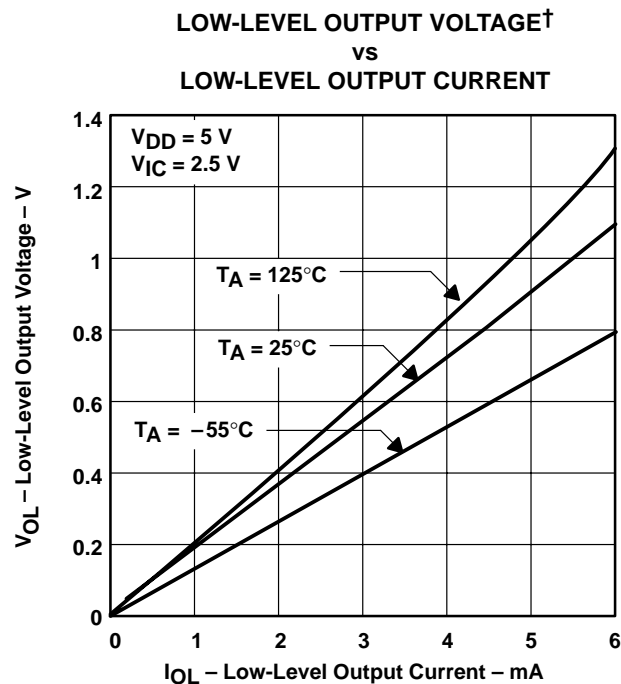


Figure 16

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



TYPICAL CHARACTERISTICS

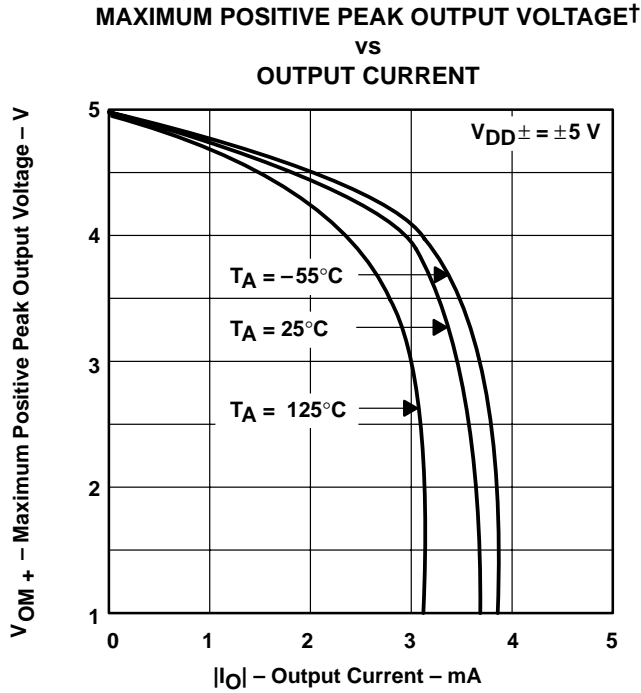


Figure 17

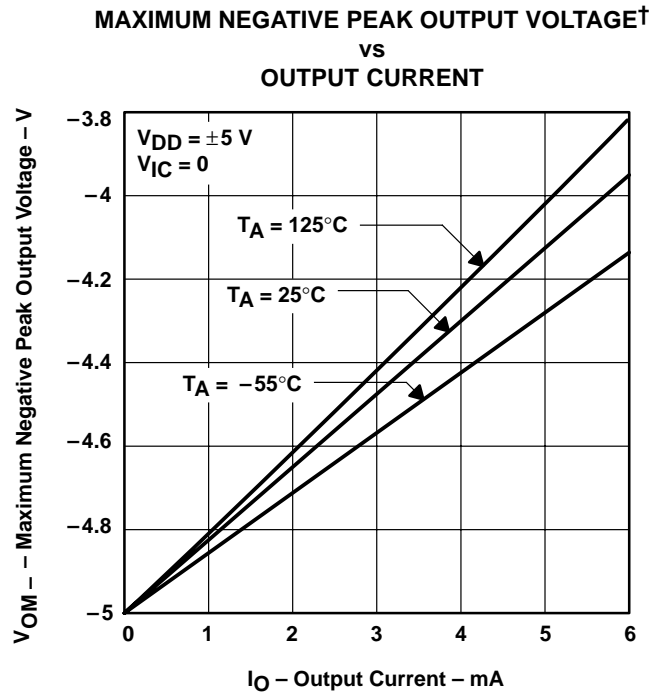


Figure 18

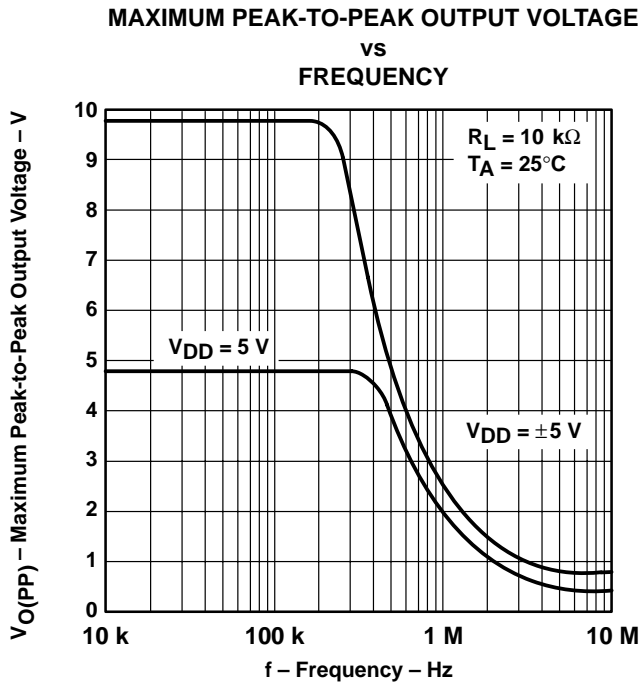


Figure 19

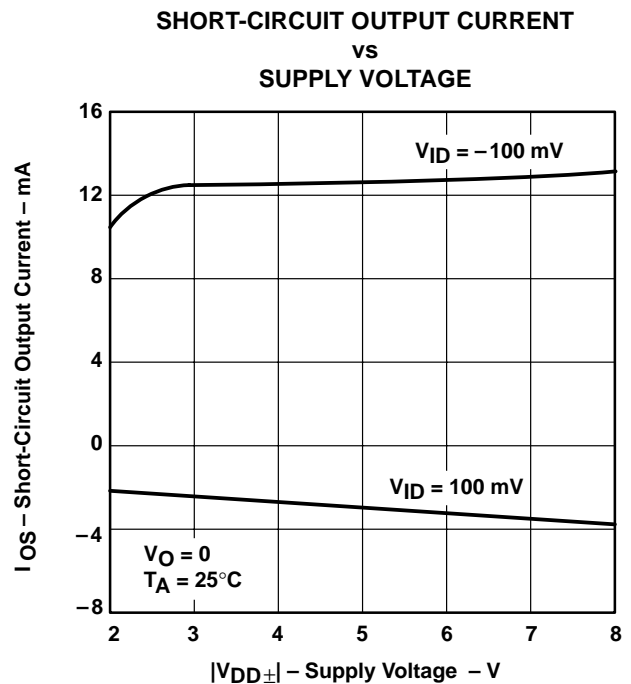


Figure 20

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

TYPICAL CHARACTERISTICS

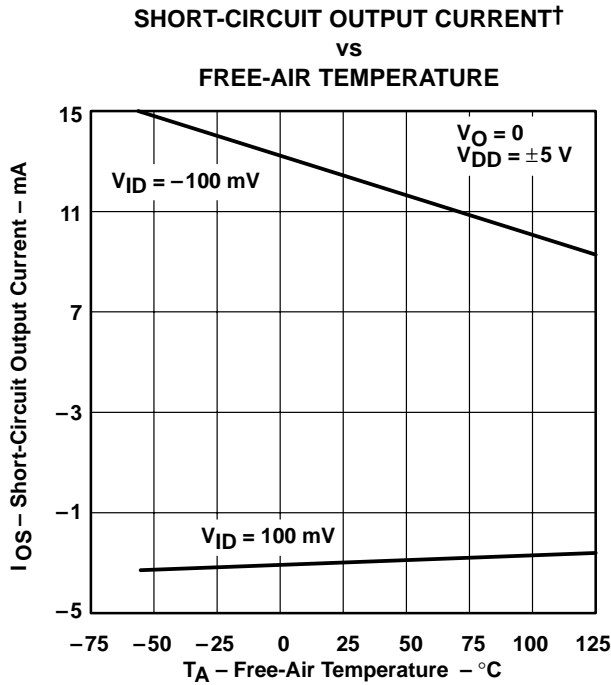


Figure 21

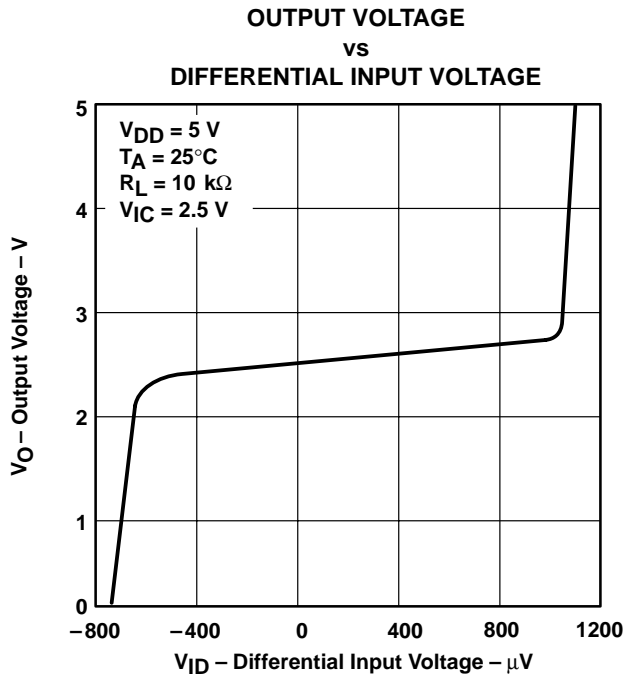


Figure 22

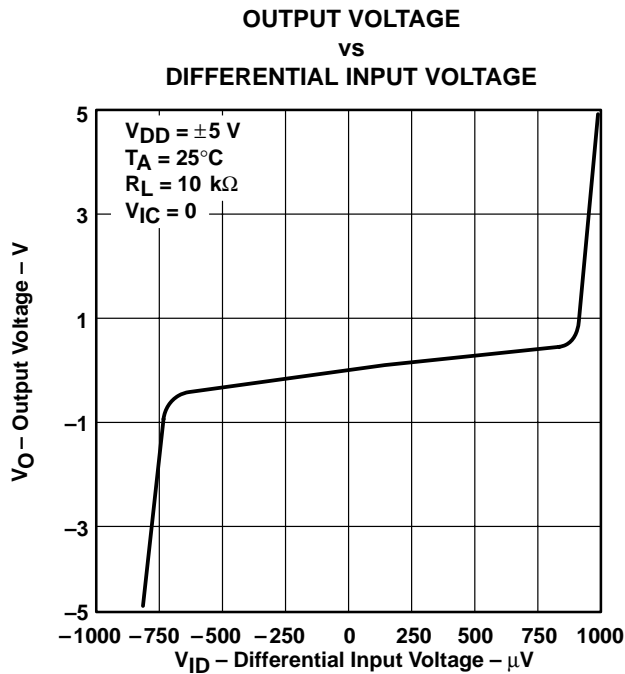


Figure 23

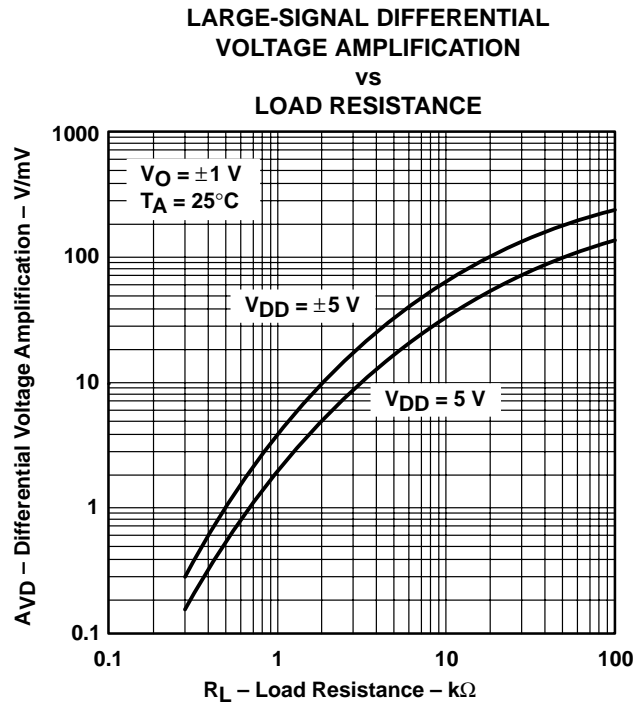


Figure 24

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

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE  
 AMPLIFICATION AND PHASE MARGIN

VS  
 FREQUENCY

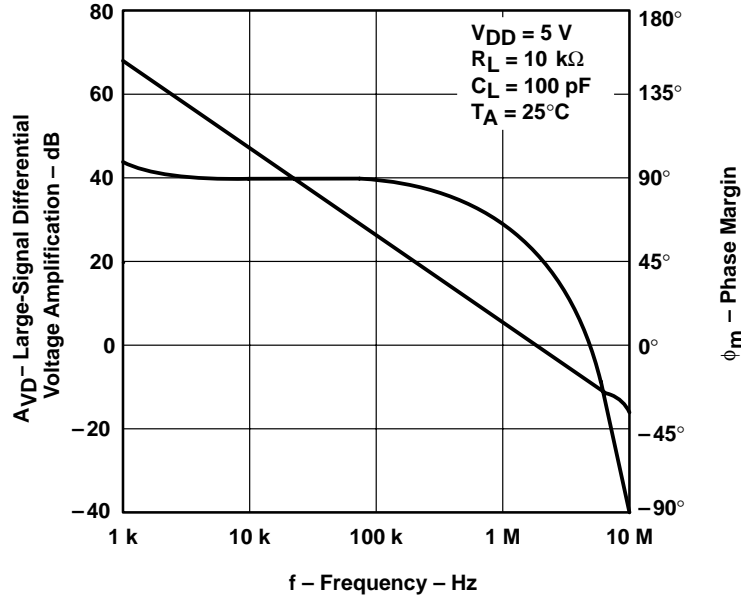


Figure 25

LARGE-SIGNAL DIFFERENTIAL VOLTAGE  
 AMPLIFICATION AND PHASE MARGIN

VS  
 FREQUENCY

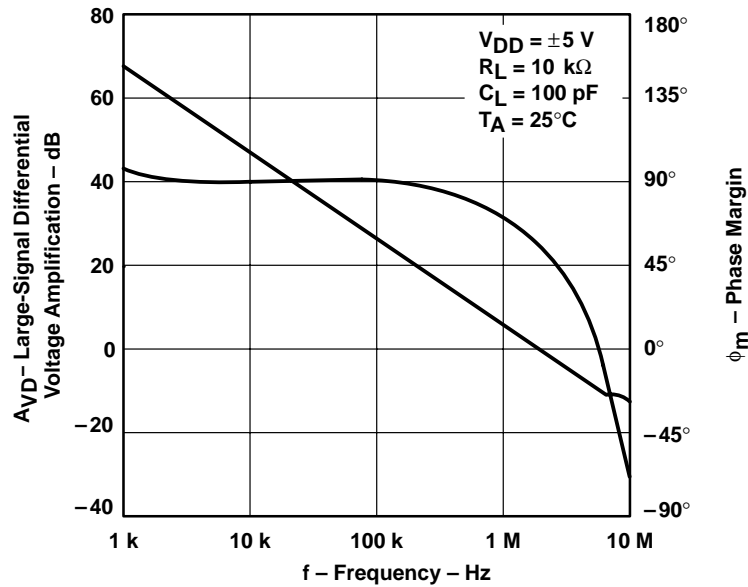


Figure 26

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL  
 VOLTAGE AMPLIFICATION†  
 vs  
 FREE-AIR TEMPERATURE

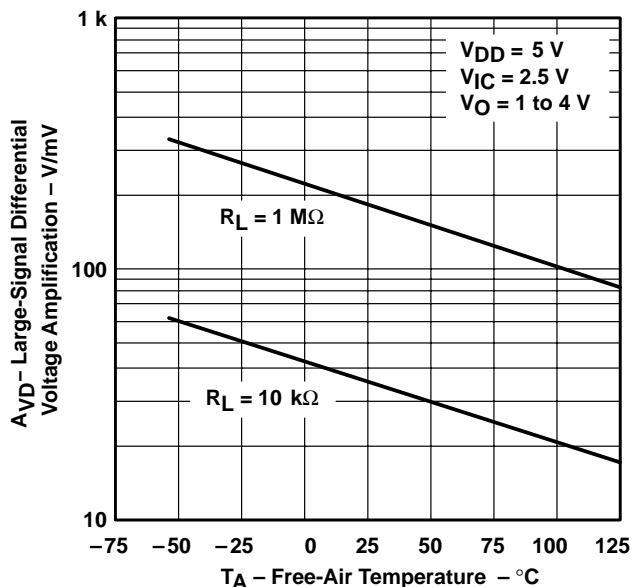


Figure 27

LARGE-SIGNAL DIFFERENTIAL  
 VOLTAGE AMPLIFICATION†  
 vs  
 FREE-AIR TEMPERATURE

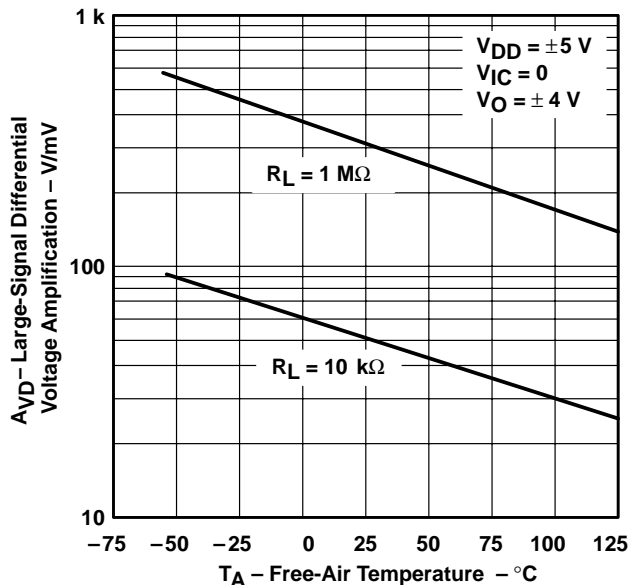


Figure 28

OUTPUT IMPEDANCE  
 vs  
 FREQUENCY

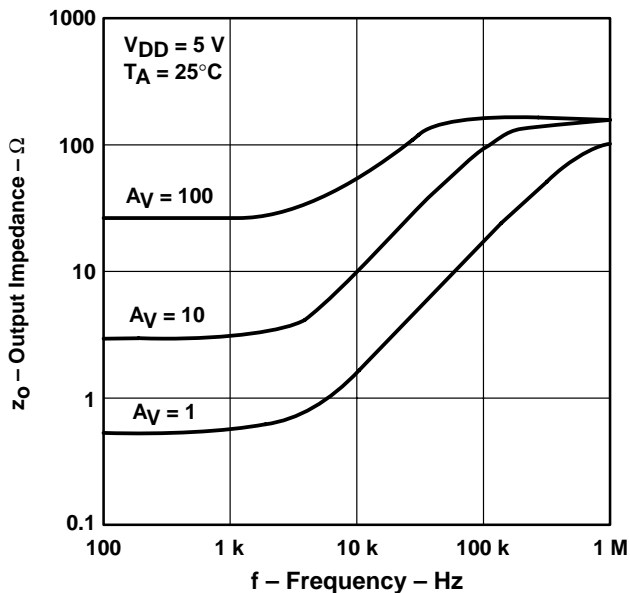


Figure 29

OUTPUT IMPEDANCE  
 vs  
 FREQUENCY

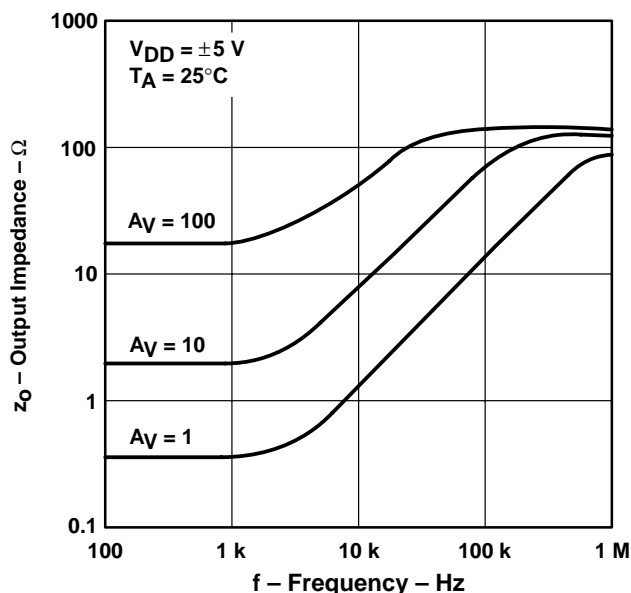


Figure 30

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

TYPICAL CHARACTERISTICS

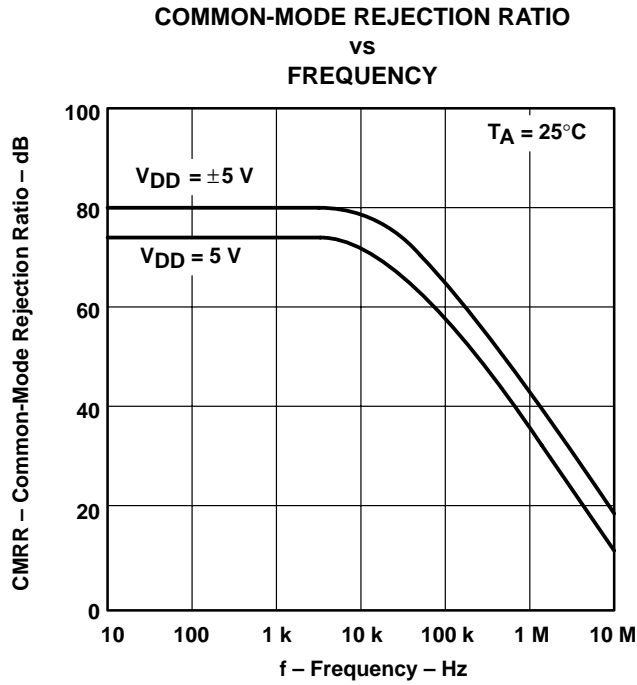


Figure 31

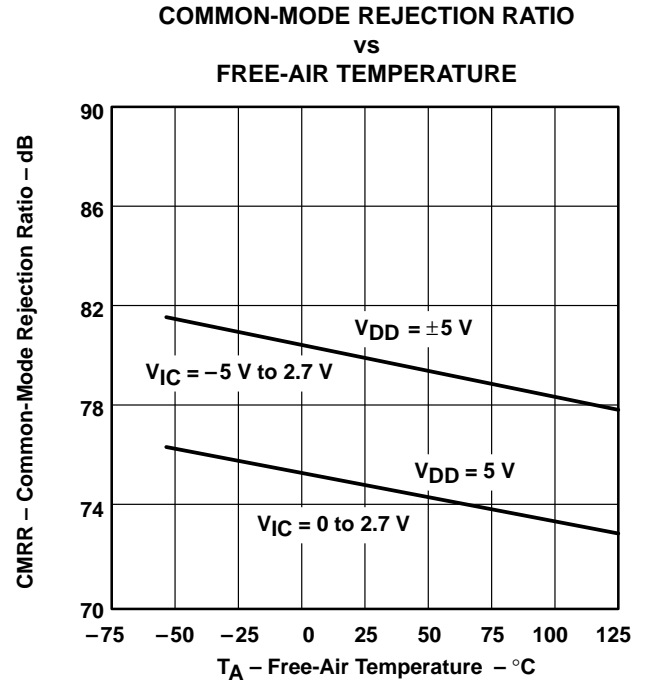


Figure 32

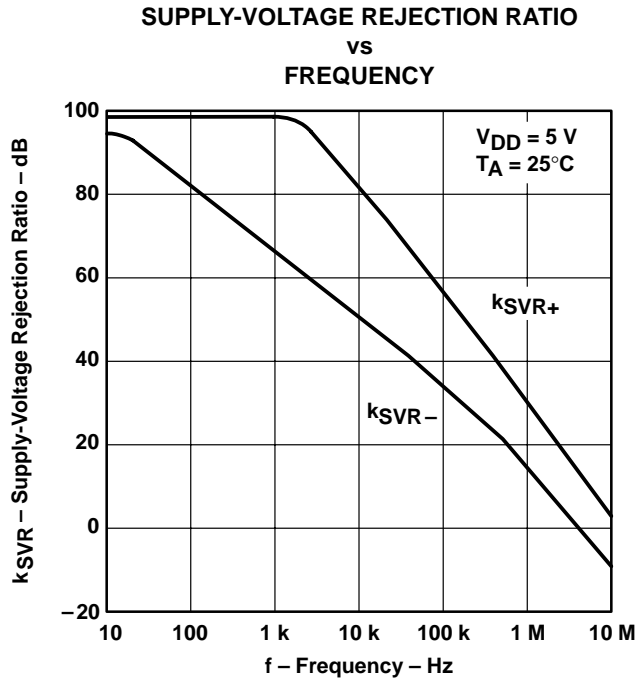


Figure 33

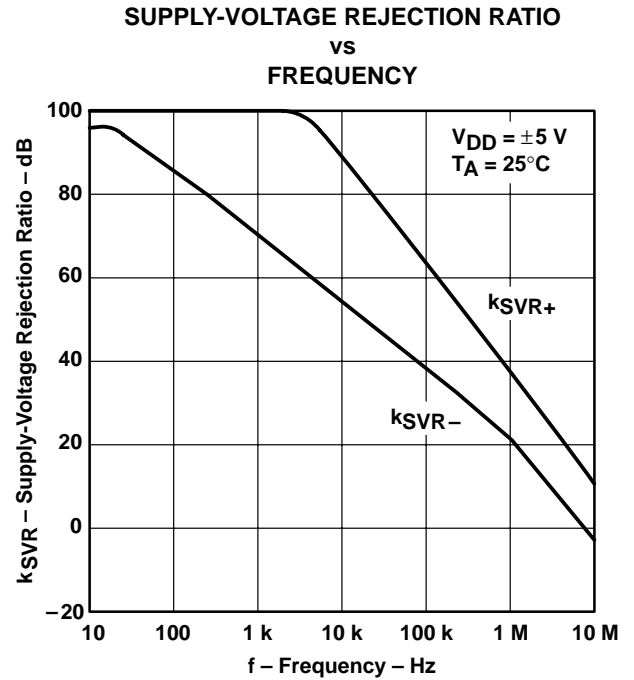
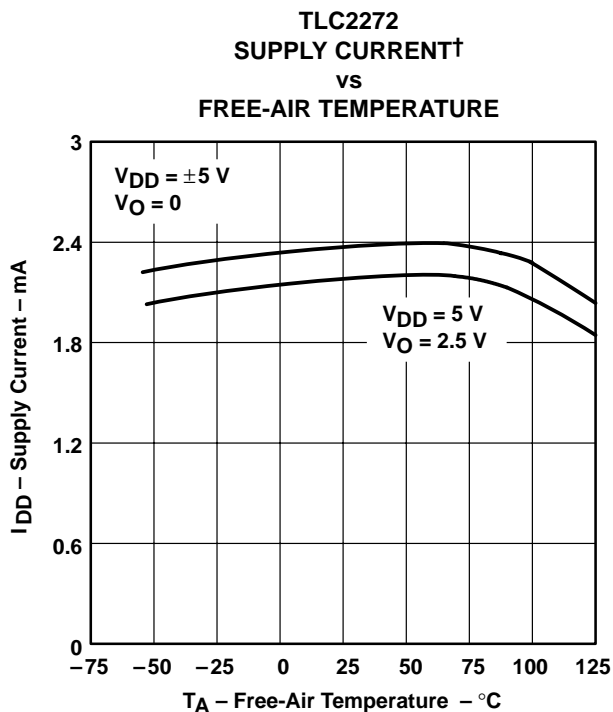
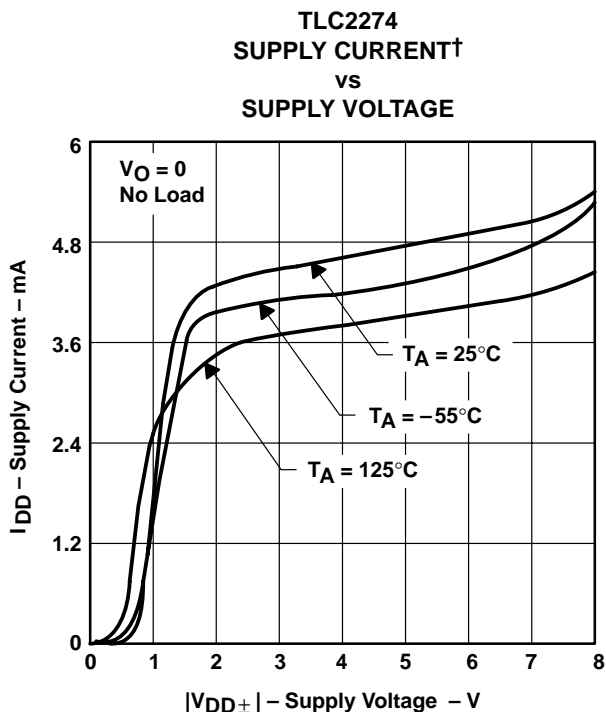
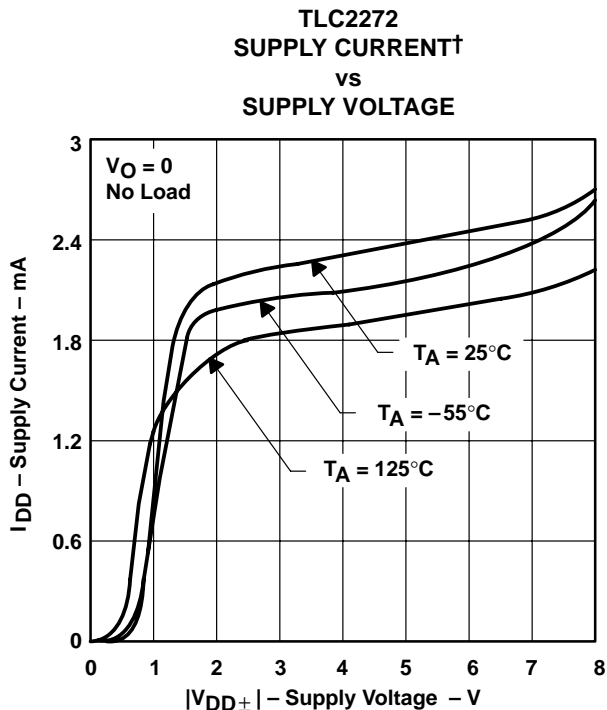
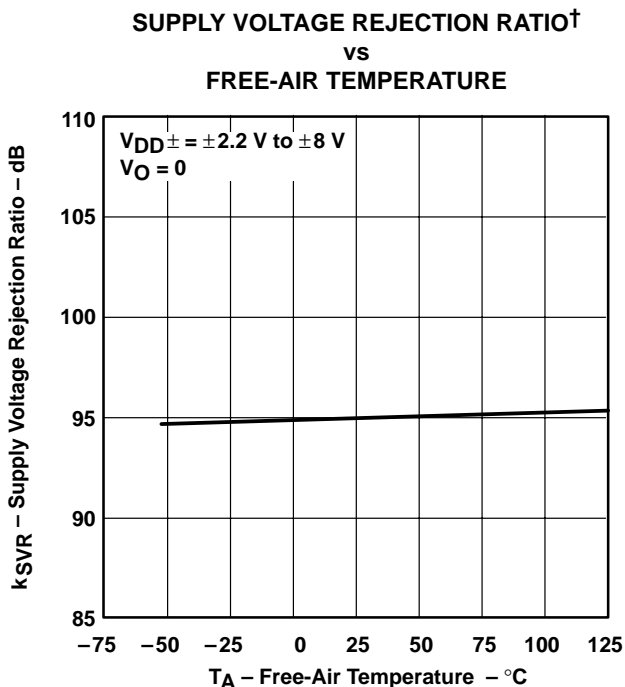


Figure 34

TYPICAL CHARACTERISTICS



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

TYPICAL CHARACTERISTICS

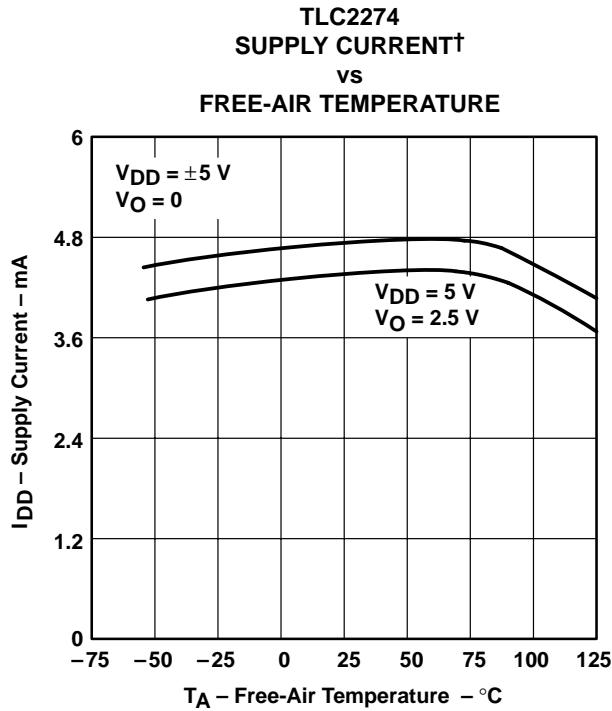


Figure 39

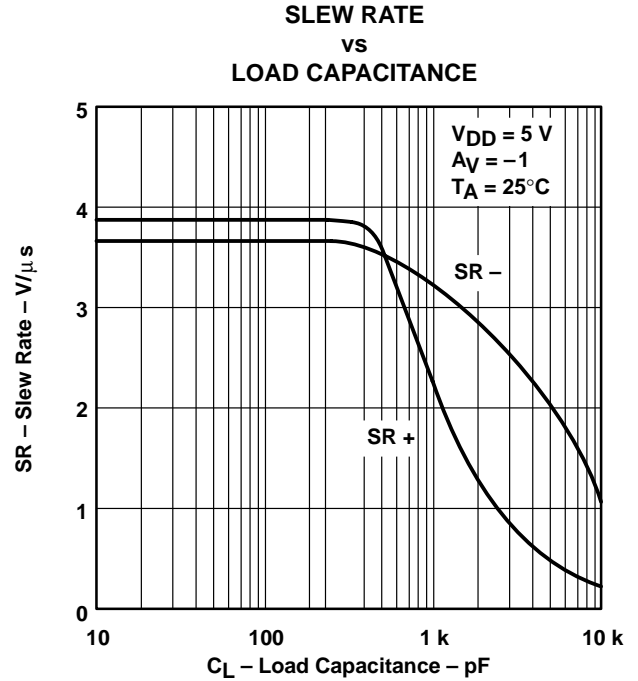


Figure 40

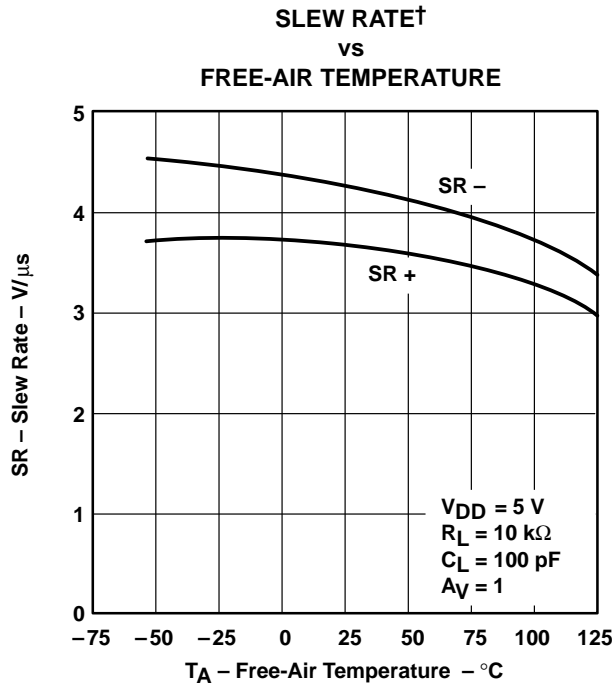


Figure 41

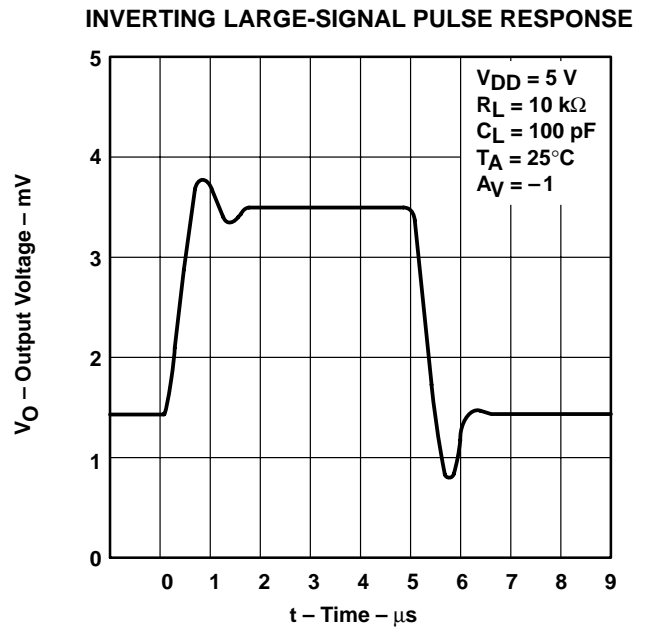


Figure 42

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

TYPICAL CHARACTERISTICS

INVERTING LARGE-SIGNAL PULSE RESPONSE

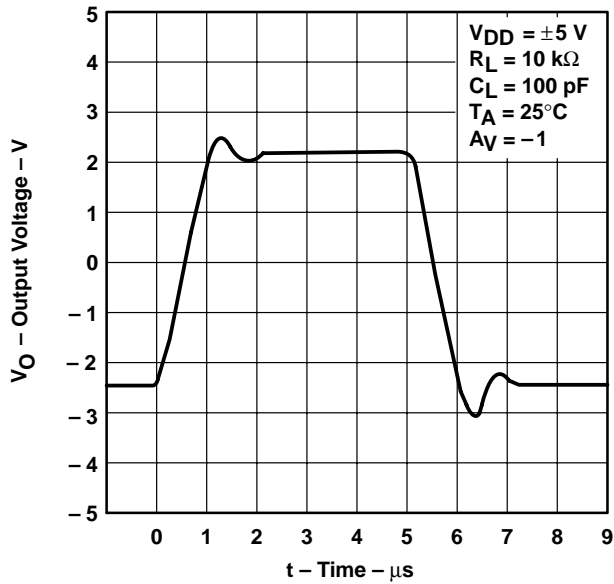


Figure 43

VOLTAGE-FOLLOWER  
 LARGE-SIGNAL PULSE RESPONSE

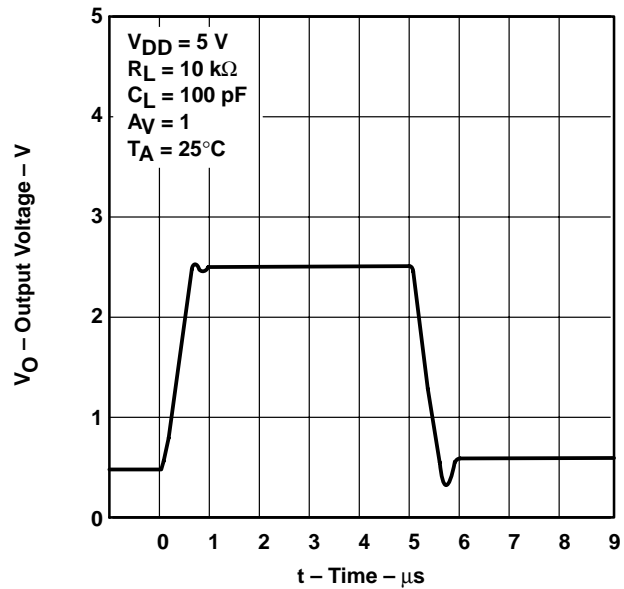


Figure 44

VOLTAGE-FOLLOWER  
 LARGE-SIGNAL PULSE RESPONSE

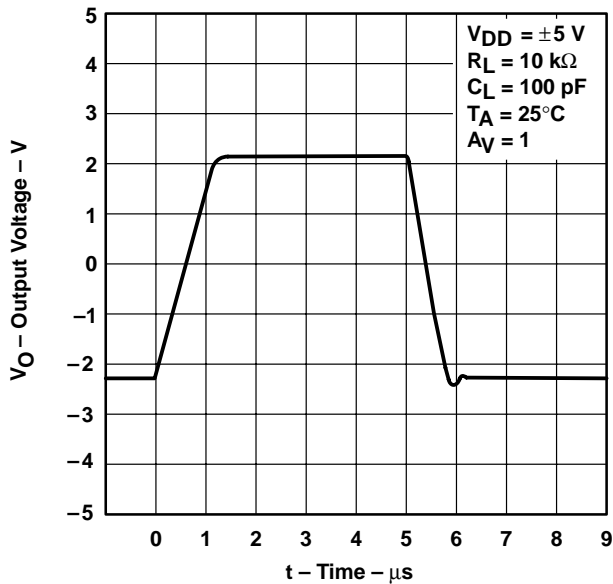


Figure 45

INVERTING SMALL-SIGNAL PULSE RESPONSE

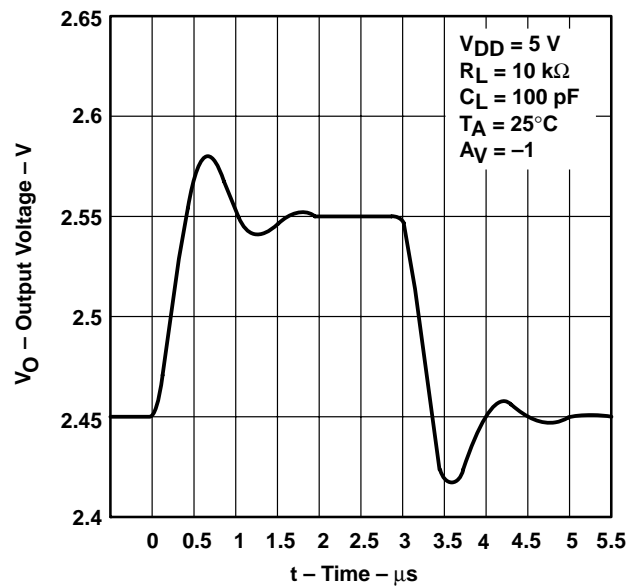


Figure 46



TYPICAL CHARACTERISTICS

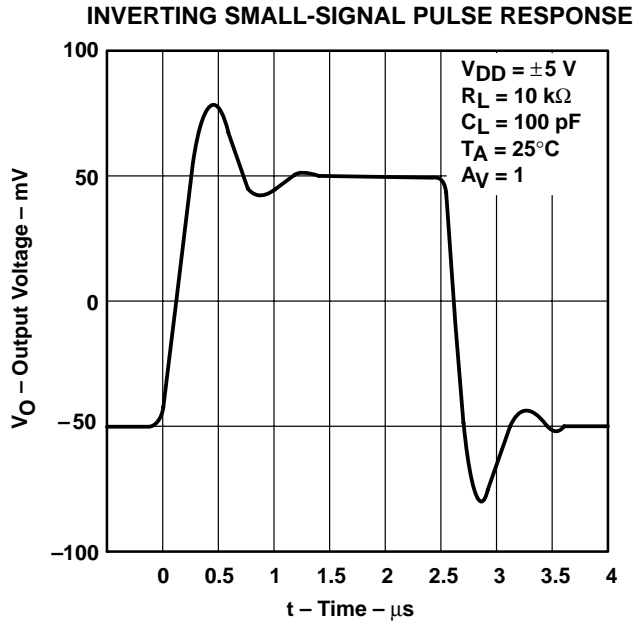


Figure 47

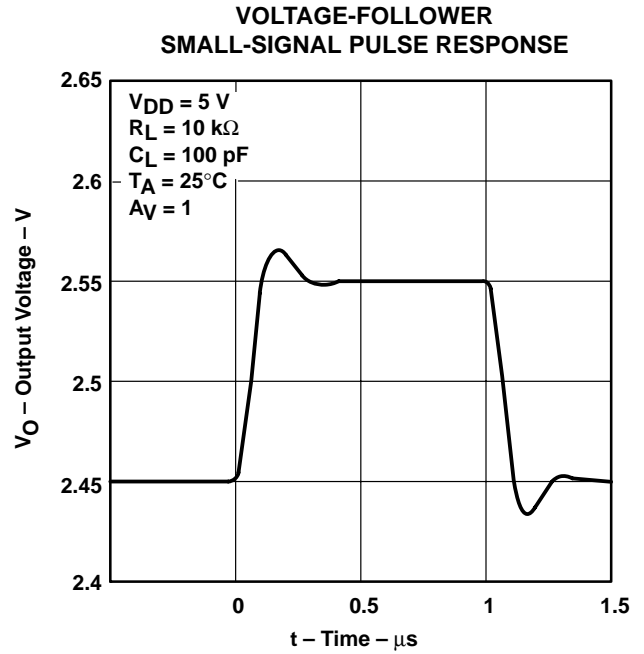


Figure 48

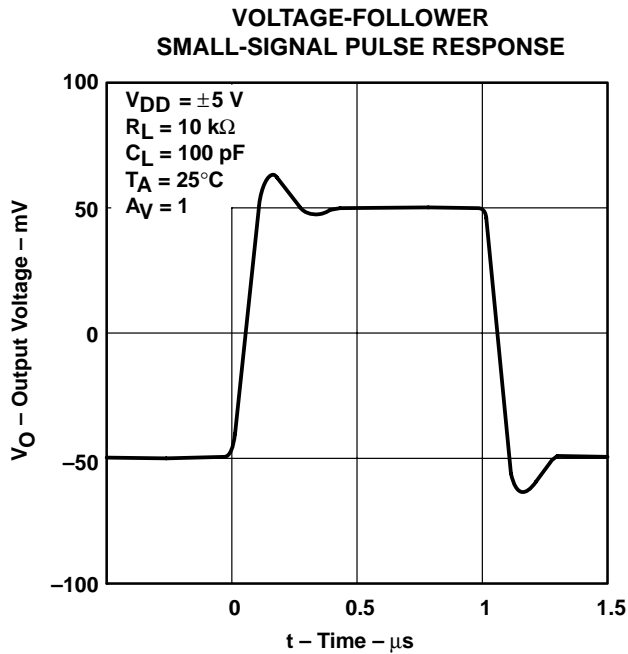


Figure 49

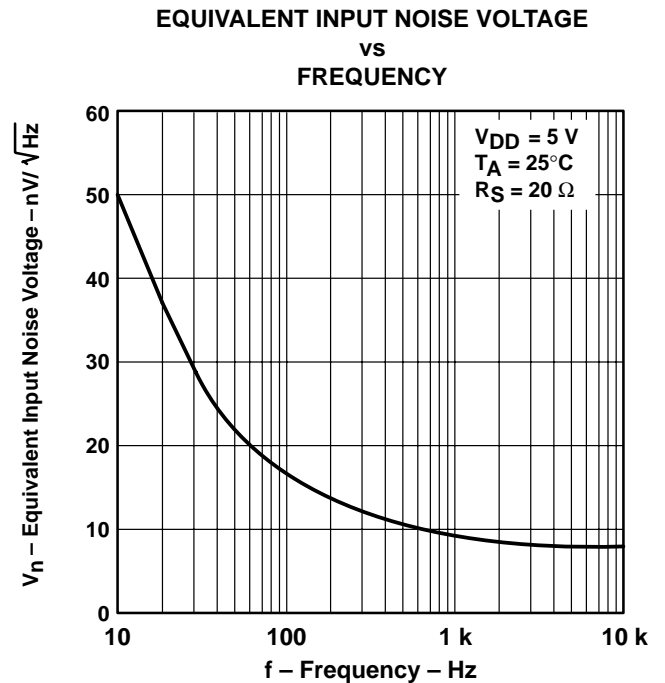


Figure 50

TYPICAL CHARACTERISTICS

EQUIVALENT INPUT NOISE VOLTAGE  
 vs  
 FREQUENCY

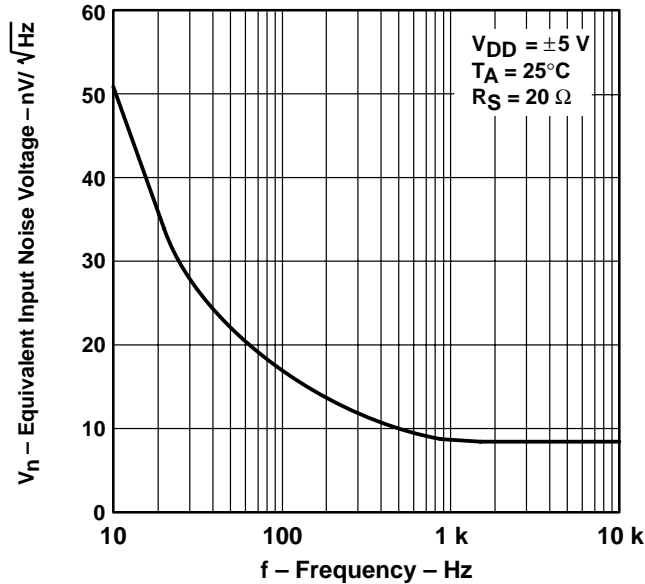


Figure 51

NOISE VOLTAGE  
 OVER A 10 SECOND PERIOD

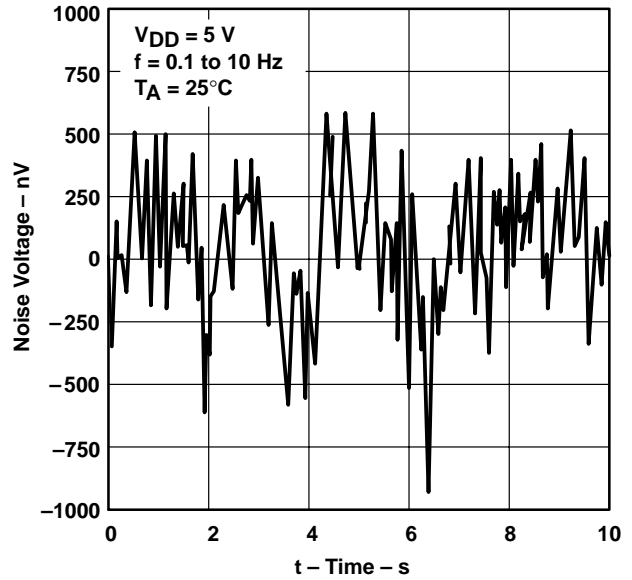


Figure 52

INTEGRATED NOISE VOLTAGE  
 vs  
 FREQUENCY

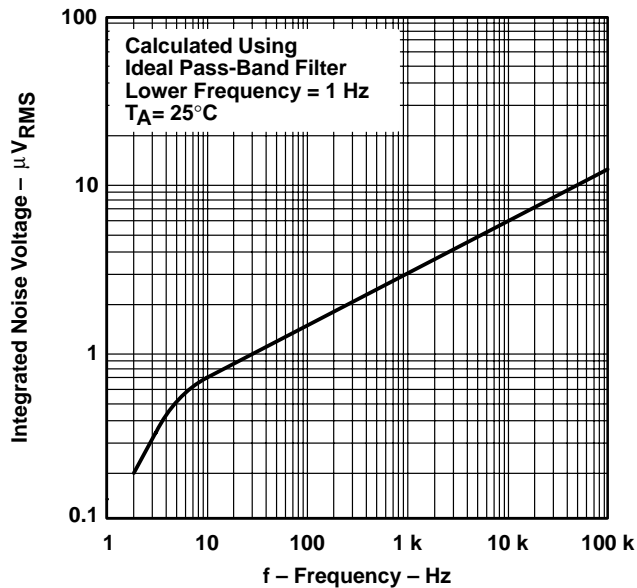


Figure 53

TOTAL HARMONIC DISTORTION PLUS NOISE  
 vs  
 FREQUENCY

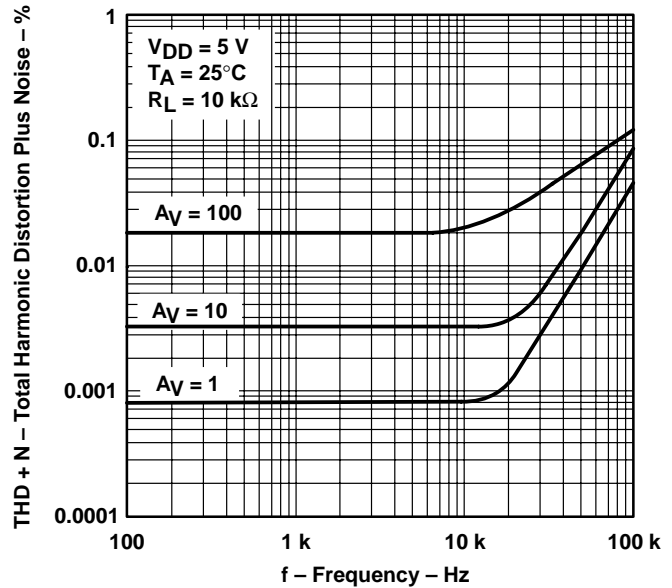


Figure 54

TYPICAL CHARACTERISTICS

GAIN-BANDWIDTH PRODUCT  
 VS  
 SUPPLY VOLTAGE

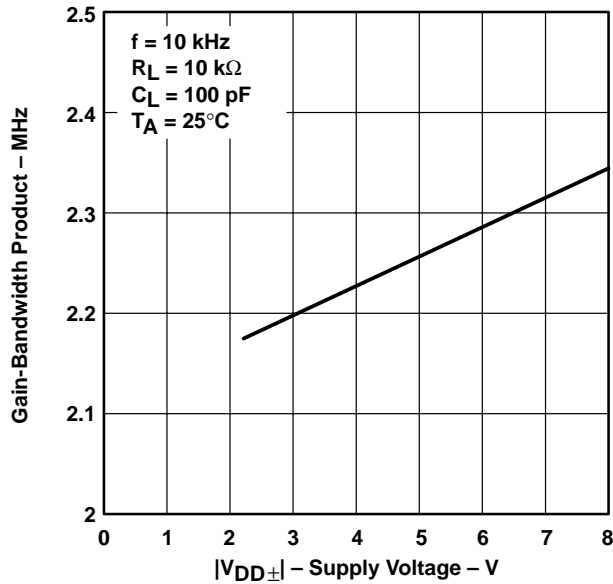


Figure 55

GAIN-BANDWIDTH PRODUCT†  
 VS  
 FREE-AIR TEMPERATURE

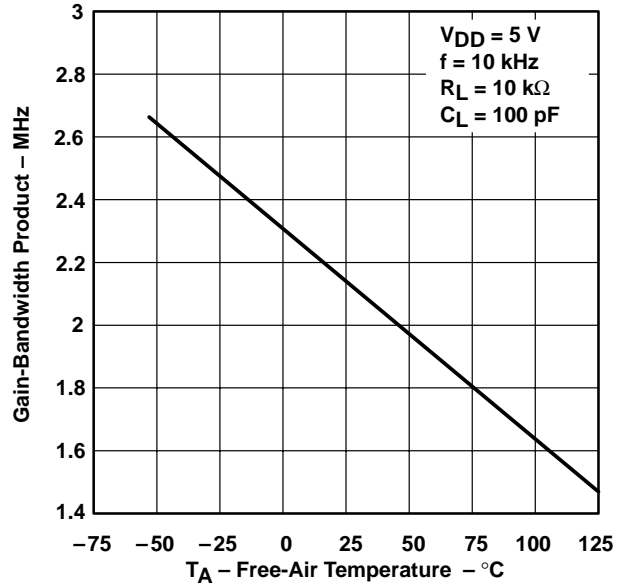


Figure 56

PHASE MARGIN  
 VS  
 LOAD CAPACITANCE

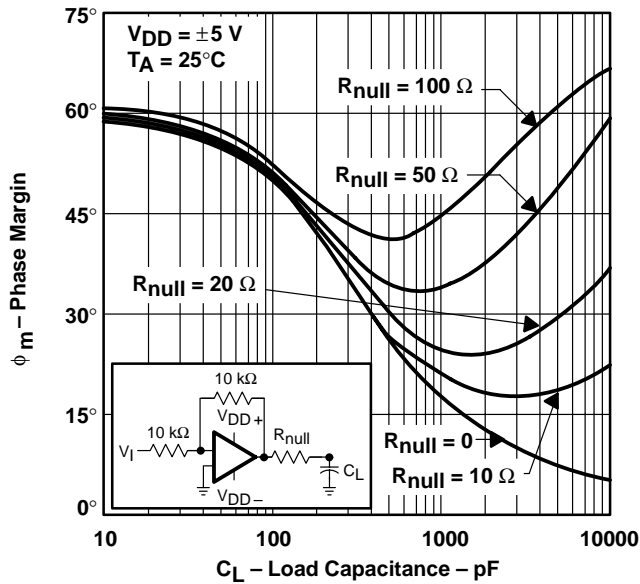


Figure 57

GAIN MARGIN  
 VS  
 LOAD CAPACITANCE

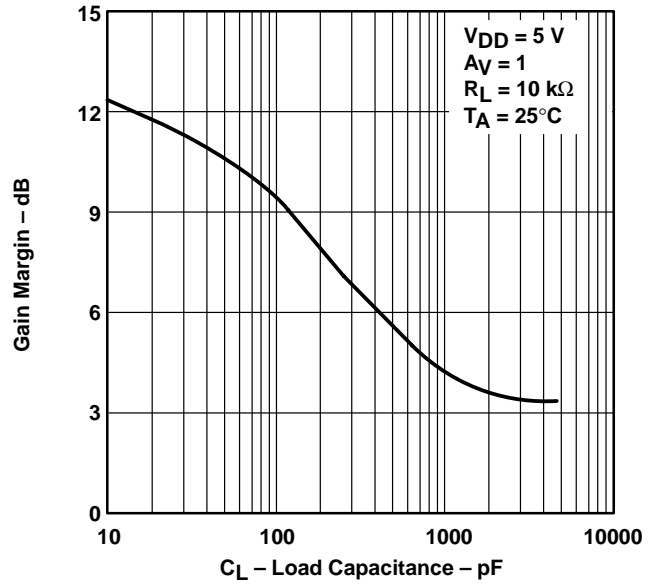


Figure 58

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

# TLC227x, TLC227xA, TLC227xY Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

SLOS190 – FEBRUARY 1997

## APPLICATION INFORMATION

### macromodel information

Macromodel information provided was derived using Microsim *Parts*™, the model generation software used with Microsim *PSpice*™. The Boyle macromodel (see Note 5) and subcircuit in Figure 59 were generated using the TLC227x typical electrical and operating characteristics at  $T_A = 25^\circ\text{C}$ . Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

- Maximum positive output voltage swing
- Maximum negative output voltage swing
- Slew rate
- Quiescent power dissipation
- Input bias current
- Open-loop voltage amplification
- Unity gain frequency
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

NOTE 5: G. R. Boyle, B. M. Cohn, D. O. Pederson, and J. E. Solomon, "Macromodeling of Intergrated Circuit Operational Amplifiers", *IEEE Journal of Solid-State Circuits*, SC-9, 353 (1974).

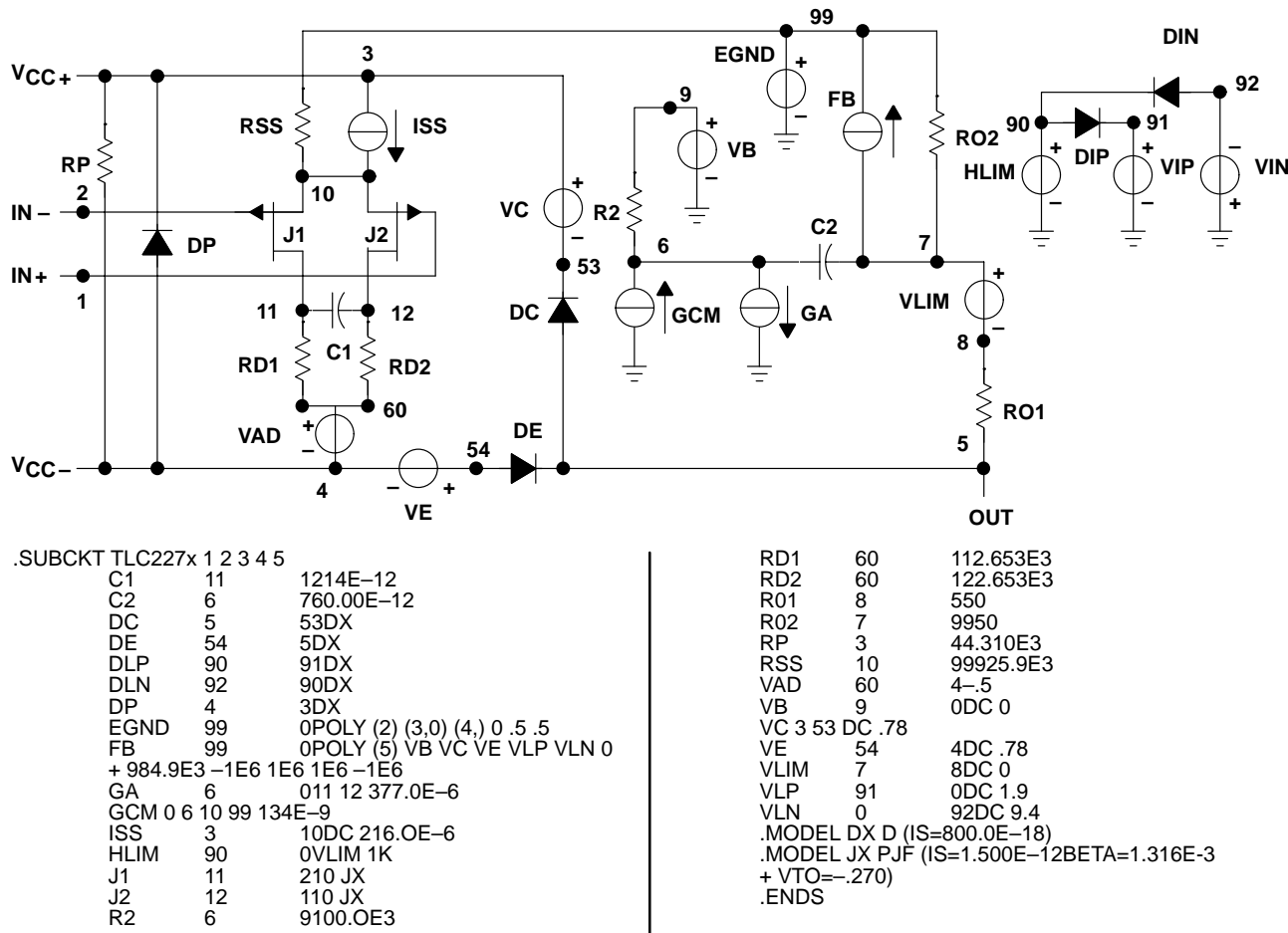


Figure 59. Boyle Macromodel and Subcircuit

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