SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

- **Output Swing Includes Both Supply Rails**
- Low Noise . . . 9 nV/ $\sqrt{\text{Hz}}$  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/us Typ

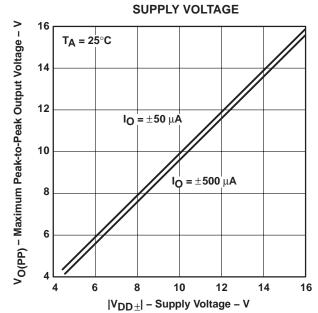
#### description

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 operational amplifiers. The TLC227x has a noise voltage of 9 nV/ $\sqrt{Hz}$ , 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 micropower 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

- Low Input Offset Voltage 950  $\mu$ V Max at T<sub>A</sub> = 25°C
- **Macromodel Included**
- Performance Upgrades for the TS272, TS274, TLC272, and TLC274
- **Available in Q-Temp Automotive HighRel Automotive Applications Configuration Control / Print Support Qualification to Automotive Standards**

## **MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE**



family a great choice when interfacing with analog-to-digital converters (ADCs). For precision applications, the TLC227xA family is available with a maximum input offset voltage of 950 μV. This family is fully characterized at 5 V and  $\pm$ 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 the TLV2432 and TLV2442 devices.

If the design requires single amplifiers, 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.



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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SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

#### **TLC2272 AVAILABLE OPTIONS**

				PACKAGED	DEVICES		_
TA	V <sub>IO</sub> max At 25°C	SMALL OUTLINE† (D)	CERAMIC LCC (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	TSSOP‡ (PW)	CERAMIC FLAT PACK (U)
0°C to 70°C	950 μV 2.5 mV	TLC2272ACD TLC2272CD			TLC2272ACP TLC2272CP	TLC2272ACPW TLC2272CPW	
-40°C to 125°C	950 μV 2.5 mV	TLC2272AID TLC2272ID	_	_	TLC2272AIP TLC2272IP	— TLC2272IPW	_
-40°C to 125°C	950 μV 2.5 mV	TLC2272AQD TLC2272QD	<u>-</u>	<u>-</u>	_	TLC2272AQPW TLC2272QPW	<u> </u>
-55°C to 125°C	950 μV 2.5 mV	TLC2272AMD TLC2272MD	TLC2272AMFK TLC2272MFK	TLC2272AMJG TLC2272MJG	TLC2272AMP TLC2272MP	_	TLC2272AMU TLC2272MU

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

#### **TLC2274 AVAILABLE OPTIONS**

				PACKAGE	D DEVICES	_	_
T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	SMALL OUTLINE† (D)	CERAMIC LCC (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	TSSOP <sup>‡</sup> (PW)	CERAMIC FLAT PACK (W)
0°C to 70°C	950 μV 2.5 mV	TLC2274ACD TLC2274CD	_	_	TLC2274ACN TLC2274CN	TLC2274ACPW TLC2274CPW	
4000 1- 40500	950 μV 2.5 mV	TLC2274AID TLC2274ID	_	_	TLC2274AIN TLC2274IN	TLC2274AIPW TLC2274IPW	_
-40°C to 125°C	950 μV TLC2274AQD — — — —		_	_	_	_	
-55°C to 125°C	950 μV 2.5 mV	TLC2274AMD TLC2274MD	TLC2274AMFK TLC2274MFK	TLC2274AMJ TLC2274MJ	TLC2274AMN TLC2274MN	_	TLC2274AMW TLC2274MW

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



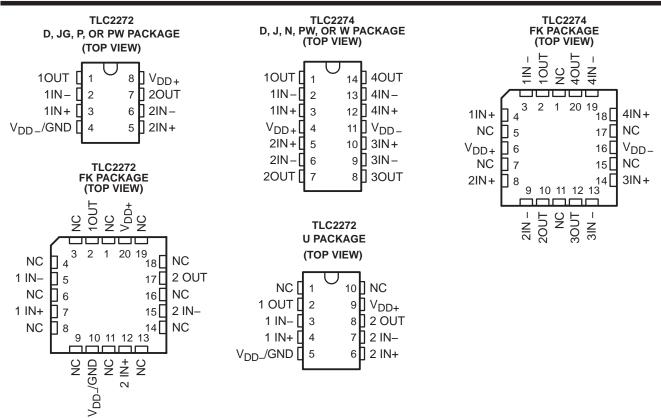
<sup>&</sup>lt;sup>‡</sup> The PW package is available taped and reeled. Add R suffix to the device type (e.g., TLC2272PWR).

<sup>§</sup> Chips are tested at 25°C.

<sup>&</sup>lt;sup>‡</sup>The PW package is available taped and reeled.

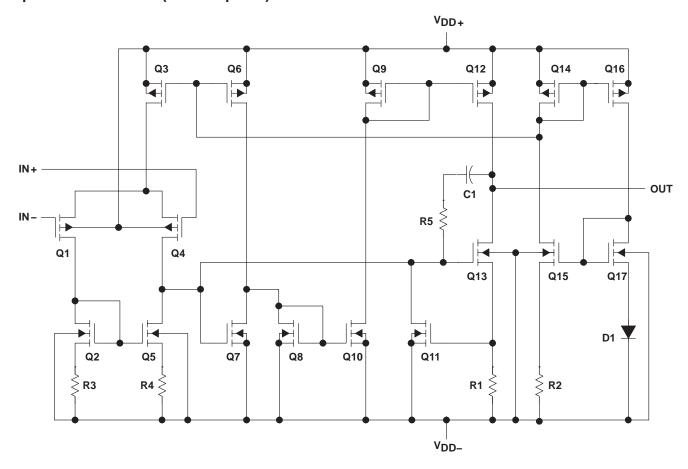
<sup>§</sup> Chips are tested at 25°C.

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004



NC - No internal connection

#### equivalent schematic (each amplifier)



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

<sup>†</sup> Includes both amplifiers and all ESD, bias, and trim circuitry

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

,	Supply voltage, V <sub>DD+</sub> (see Note 1)			8 V
	Input voltage range, $V_{\rm I}$ (any input, see Note 2)			
	Input current, I <sub>I</sub> (any input)			
	Output current, IO			
	Total current into V <sub>DD+</sub>			
•	Total current out of V <sub>DD</sub>			±50 mA
	Duration of short-circuit current at (or below)	25°C (see	Note 3)	unlimited
	Package thermal impedance, $ heta_{\sf JA}$ (see Notes	s 4 and 5):		
			D package (14 pin)	
			N package	79.7°C/W
			P package	
			PW package (8 pin)	149°C/W
			PW package (14 pin)	113°C/W
	Package thermal impedance, $\theta_{\sf JC}$ (see Notes	s 4 and 5):		
			J package	15.1°C/W
			U package	
(	Operating free-air temperature range, TA: C	Csuffix		0°C to 70°C
	N	∕I suffix		–55°C to 125°C
,	Storage temperature range			65°C to 150°C
	Lead temperature 1,6 mm (1/16 inch) from ca	ase for 10	seconds: D, N, P or PW packa	age 260°C
-	Lead temperature 1,6 mm (1/16 inch) from ca	ase for 60	seconds: J or U package	300°C

<sup>†</sup> 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 VDD+ and VDD -.
  - 2. Differential voltages are at IN+ with respect to IN –. Excessive current will flow if input is brought below V<sub>DD</sub> 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.
  - 4. Maximum power dissipation is a function of  $T_J(max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(max) T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
  - 5. The package thermal impedance is calculated in accordance with JESD 51-7 (plastic) or MIL-STD-883 Method 1012 (ceramic).

#### recommended operating conditions

	C	C SUFFIX		SUFFIX	Q :	SUFFIX	М :	SUFFIX	LINUT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	UNIT
Supply voltage, V <sub>DD±</sub>	±2.2	±8	±2.2	±8	±2.2	±8	±2.2	±8	V
Input voltage, V <sub>I</sub>	$V_{DD-}$	V <sub>DD+</sub> -1.5	V						
Common-mode input voltage, V <sub>IC</sub>	$V_{DD-}$	V <sub>DD+</sub> -1.5	V						
Operating free-air temperature, TA	0	70	-40	125	-40	125	-55	125	°C



SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	DADAMETED	TEST COL	IDITIONS	T. +	T	LC22720		TL	.C2272A	C	
	PARAMETER	TEST CON	IDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
VIO	Input offset voltage			25°C		300	2500		300	950	μV
V10	input onset voltage	]		Full range			3000			1500	μν
αΝΙΟ	Temperature coefficient of input offset voltage			25°C to 70°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0 \text{ V},$ $V_{DD} \pm = \pm 2.5 \text{ V},$ $V_{O} = 0 \text{ V},$ $R_{S} = 50 \Omega$		25°C		0.002			0.002		μV/mo
IIO	Input offset current	1.5		25°C		0.5	60		0.5	60	pА
10				Full range			100			100	F
I <sub>IB</sub>	Input bias current			25°C		1	60		1	60	pА
.ID				Full range			100			100	P
VICR	Common-mode input	R <sub>S</sub> = 50 Ω,	V <sub>IO</sub>   ≤ 5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
VICK	voltage	113 - 00 22,	14101=01114	Full range	0 to 3.5			0 to 3.5			v
		$I_{OH} = -20 \mu A$		25°C		4.99			4.99		
	High lovel output	I <sub>OH</sub> = -200 μA		25°C	4.85	4.93		4.85	4.93		
۷он	High-level output voltage	10Η = -200 μΑ		Full range	4.85			4.85			V
	renage	I <sub>OH</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65		
		IOH = = I IIIA		Full range	4.25			4.25			
		$V_{IC} = 2.5 V,$	I <sub>OL</sub> = 50 μA	25°C		0.01			0.01		
		V <sub>IC</sub> = 2.5 V,	I <sub>OL</sub> = 500 μA	25°C		0.09	0.15		0.09	0.15	
$V_{OL}$	Low-level output voltage	VIC = 2.5 V,	10L = 300 μΑ	Full range			0.15			0.15	V
		V <sub>IC</sub> = 2.5 V,	$I_{OL} = 5 \text{ mA}$	25°C		0.9	1.5		0.9	1.5	
		VIC = 2.5 V,	10L = 3 111A	Full range			1.5			1.5	
	Laura simual diffarential	V 0.5.V	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	15	35		15	35		
AVD	Large-signal differential voltage amplification	$V_{IC} = 2.5 \text{ V},$ $V_{O} = 1 \text{ V to 4 V}$	K[ = 10 K22+	Full range	15			15			V/mV
	voltage amplification	VO = 1 V 10 4 V	$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
rid	Differential input resistance			25°C		10 <sup>12</sup>			1012		Ω
rį	Common-mode input resistance			25°C		1012			1012		Ω
ci	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		140			140		Ω
01/55	Common-mode	V <sub>IC</sub> = 0 V to 2.7 \	/,	25°C	70	75		70	75		
CMRR	rejection ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	70			70			dB
ksvr	Supply-voltage rejection ratio	V <sub>DD</sub> = 4.4 V to 16	V,V <sub>IC</sub> = V <sub>DD</sub> /2,	25°C	80	95		80	95		dB
-541	$(\Delta V_{DD}/\Delta V_{IO})$	No load		Full range	80			80			
		V 05V	Natard	25°C		2.2	3		2.2	3	A
I <sub>DD</sub>	Supply current	$V_0 = 2.5 V$ ,	No load	Full range			3			3	mA

<sup>†</sup> Full range is 0°C to 70°C.

NOTE 6: Typical values are based on the input offset voltage shift observed through 168 hours of operating life test at  $T_A = 150$ °C extrapolated to  $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



<sup>‡</sup>Referenced to 0 V

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

	DADAMETED	TEAT CONDITI	ONO	- +	Т	LC22720	;	TI	LC2272A	С	LINUT		
'	PARAMETER	TEST CONDITI	ONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT		
	Slew rate at unity	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$		25°C	2.3	3.6		2.3	3.6				
SR	gain	$R_L = 10 \text{ k}\Omega^{\ddagger}, \qquad C_L = 10 \text{ k}\Omega^{\ddagger}$	= 100 pF‡	Full range	1.7			1.7	1.7		V/μs		
	Equivalent input	f = 10 Hz		25°C		50		50			nV/√ <del>Hz</del>		
Vn	noise voltage	f = 1 kHz		25°C		9		9			nv/√Hz		
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1							
VNPP	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4				μV			
In	Equivalent input noise current			25°C		0.6		0.6			fA/√Hz		
		$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	A <sub>V</sub> = 1			0.0013%			0.0013%				
THD + N	Total harmonic distortion plus noise	f = 20 kHz,	A <sub>V</sub> = 10	25°C		0.004%			0.004%				
	distortion plus holse	$R_L = 10 \text{ k}\Omega^{\ddagger}$	A <sub>V</sub> = 100		0.03%			0.03%					
	Gain-bandwidth product	$f = 10 \text{ kHz}, R_L = 100 \text{ pF}^{\ddagger}$	= 10 kΩ <sup>‡</sup> ,	25°C	2.18			2.18			MHz		
ВОМ	Maximum output-swing bandwidth	$V_{O(PP)} = 2 \text{ V}, \qquad A_{V} = R_{L} = 10 \text{ k}\Omega^{\ddagger}, \qquad C_{L} = 0$	= 1, = 100 pF‡	25°C		1			1		MHz		
	Cattling time	$A_V = -1$ , Step = 0.5 V to 2.5 V,		25°C		1.5	1.5		1.5				
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$ To 0.01%		20 0	2.6		2.6		2.6		2.6		μ\$
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega^{\ddagger}, \qquad C_L = 100 \text{ pF}^{\ddagger}$		25°C	50°			50°					
	Gain margin	$R_{L} = 10 \text{ k}\Omega + , \qquad C_{L} = 100 \text{ pF} + $		25°C	10			dB					

<sup>†</sup> Full range is 0°C to 70°C. ‡ Referenced to 0 V



SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	PARAMETER	TEST	NDITIONS	T. +	Т	LC22720		TL	.C2272A	С	T
	PARAMETER	1231 00	MUITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V. 0	Input offset voltage			25°C		300	2500		300	950	μV
VIO	input onset voltage			Full range			3000			1500	μν
αΛΙΟ	Temperature coefficient of input offset voltage			25°C to 70°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0 \text{ V},$ $R_S = 50 \Omega$	V <sub>O</sub> = 0 V,	25°C		0.002			0.002		μV/mo
lio	Input offset current			25°C		0.5	60		0.5	60	pА
טוי	input onset current			Full range			100			100	PΛ
I <sub>IB</sub>	Input bias current			25°C		1	60		1	60	рA
.ID	mpat blac carrent			Full range			100			100	P
Vion	Common-mode input	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
VICR	voltage	NS = 50 \$2,	lvIO l≥2 iiiv	Full range	-5 to 3.5			-5 to 3.5			V
		$I_0 = -20 \mu A$		25°C		4.99			4.99		
	Maximum positive peak	Ja - 200 u/		25°C	4.85	4.93		4.85	4.93		
VOM+	OM+ output voltage	$I_{O} = -200 \mu$	`	Full range	4.85			4.85			V
	output romago	I <sub>O</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65		
		10 = -1111A		Full range	4.25			4.25			
		$V_{IC} = 0 V$	$I_0 = 50  \mu A$	25°C		-4.99			-4.99		
	Maximum negative peak	V <sub>IC</sub> = 0 V,	ΙΟ = 500 μΑ	25°C	-4.85	-4.91		-4.85	-4.91		
VOM−	output voltage	10 0 1,	10 = 300 μΑ	Full range	-4.85			-4.85			V
		$V_{IC} = 0 V$	$I_O = 5 \text{ mA}$	25°C	-3.5	-4.1		-3.5	-4.1		
		10 ,	<del>-</del>	Full range	-3.5			-3.5			
	Large-signal differential		R <sub>L</sub> = 10 kΩ	25°C	25	50		25	50		
AVD	voltage amplification	$V_O = \pm 4 V$		Full range	25			25			V/mV
			$R_L = 1 \text{ m}\Omega$	25°C		300			300		
<sup>r</sup> id	Differential input resistance			25°C		1012			1012		Ω
rį	Common-mode input resistance			25°C		1012			1012		Ω
Cį	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
OMES	Common-mode rejection	$V_{IC} = -5 \text{ V to}$	2.7 V,	25°C	75	80		75	80		i
CMRR	ratio	$V_O = 0 V$	$R_S = 50 \Omega$	Full range	75			75			dB
1-	Supply-voltage rejection	V <sub>DD±</sub> = 2.2 \	√ to ±8 V.	25°C	80	95		80	95		- 10
ksvr	ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{IC} = 0 V$	No load	Full range	80			80			dB
		.,		25°C		2.4	3		2.4	3	_
IDD	Supply current	VO = 0 V	No load	Full range			3			3	mA

<sup>†</sup> 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  $T_A = 150$ °C extrapolated to  $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

	PARAMETER	TEST CONDITIO		_ +		TLC22720	;	Т	LC2272A	С	
P/	ARAMETER	TEST CONDITION	ONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	01	V 100V	4010	25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_O = \pm 2.3 \text{ V},$ R $C_L = 100 \text{ pF}$	L = 10 kΩ,	Full range	1.7			1.7			V/μs
.,	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ <del>Hz</del>
V <sub>n</sub>	noise voltage	f = 1 kHz		25°C		9			9		nv/√Hz
\/	Peak-to-peak equivalent input	f = 0.1 Hz to 1 Hz		25°C		1			1		/
V <sub>NPP</sub>	noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	V <sub>O</sub> = ±2.3 V,	A <sub>V</sub> = 1			0.0011%			0.0011%		
THD + N	distortion pulse	f = 20 kHz,	A <sub>V</sub> = 10	25°C		0.004%			0.004%		
	duration	$R_L = 10 \text{ k}\Omega$	A <sub>V</sub> = 100			0.03%			0.03%		
	Gain-bandwidth product	$f = 10 \text{ kHz},$ R $C_L = 100 \text{ pF}$	L = 10 kΩ,	25°C		2.25			2.25		MHz
ВОМ	Maximum output- swing bandwidth		v = 1, L = 100 pF	25°C		0.54			0.54		MHz
	Cattling time	$A_V = -1$ , Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		
t <sub>S</sub>	Settling time	$R_L$ = 10 kΩ, $C_L$ = 100 pF	To 0.01%	25°C		3.2			3.2		μS
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega,$	i = 100 pF	25°C		52°			52°		
	Gain margin	1 -	- '	25°C		10			10		dB

<sup>†</sup>Full range is 0°C to 70°C.

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

Vio   Input offset voltage   Emperature coefficient of input offset voltage   Input offset current   Vio   Vio   O V   Vio   O Vio   O V   Vio   O Vio   O V   O V   Vio   O V   O V   Vio   O V   Vio   O V   Vio   O V   Vio   O V		DADAMETED	TEST CON	IDITIONS	- +	Т	LC2274	С	TL	C2274A	C	
Full range   3000   1500   μV   1500   μV   1500   μV   1500   μV   1500   1500		PARAMETER	IESI CON	NDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
Temperature coefficient of input offset voltage input offset current in input input bias current   Vica	V/10	Input offset voltage			25°C		300	2500		300	950	\/
The first voltage   Input offset current   VOD ± = ±2.5 V, VO = 0 V,	۷IO	iliput oliset voltage			Full range			3000			1500	μν
long-term drift (see Note 4)   VO = 0 V,   VO = 0 V,   VO = 0 V,   VO = 0 V,   RS = 50 Ω   PA     Input offset current   Input offset current   Input bias current   Input bias current   RS = 50 Ω,   Input bias current   VOR   VOITE   V	αΝΙΟ						2			2		μV/°C
Input offset current   Full range		long-term drift	$V_{DD\pm} = \pm 2.5 \text{ V},$ $V_{O} = 0 \text{ V},$	$V_{IC} = 0 V$ , $R_S = 50 \Omega$	25°C		0.002			0.002		μV/mo
The provided input provided input voltage   Policy   P	lio.	Input offeet current	]		25°C		0.5	60		0.5	60	nΔ
Input bias current   Full range   100	10	Input onset current	]		Full range			100			100	PΛ
Vical   Vic	lin	Innut hiss current			25°C		1	60		1	60	nΔ
$V_{\text{ICR}} = \begin{array}{c} \text{Common-mode input voltage} \\ \text{VICR} = \begin{array}{c} \text{Common-mode input voltage} \\ \text{IOH} = -20 \ \mu\text{A} \\ \text{IOH} = -200 \ \mu\text{A} \\ \text{IOH} = -200 \ \mu\text{A} \\ \text{IOH} = -200 \ \mu\text{A} \\ \text{IOH} = -1 \ \text{mA} \\ $	чв	input bias current			Full range			100			100	PΑ
Voh   High-level output voltage   Full range   3.5	Vion	Common-mode input	Po = 50 O	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	25°C	_						\ <u>'</u>
$V_{OH} = \begin{array}{ c c c c c c c c c c c c c c c c c c c$	VICR	voltage	KS = 50 12,	$ V O  \geq 9 \text{ mV},$	Full range							V
$V_{OH}  \text{High-level output voltage}  \begin{array}{c ccccccccccccccccccccccccccccccccccc$			$I_{OH} = -20  \mu A$		25°C		4.99			4.99		
$V_{OL} = \frac{10 \text{High-level output voltage}}{10 \text{High-level output voltage}} = \frac{10 \text{High-level output voltage}}{10 \text{High-level output voltage}} = \frac{25^{\circ}\text{C}}{10 \text{High-level output voltage}} = \frac{25^{\circ}\text{C}}{10 \text{High-level output voltage}} = \frac{25^{\circ}\text{C}}{10 \text{Low-level output voltage}} = \frac{25^{\circ}\text{C}}{10 Lo$					25°C	4.85	4.93		4.85	4.93		
$V_{OL} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	∨он	High-level output voltage	ΙΟΗ = -200 μΑ		Full range	4.85			4.85			V
$V_{OL} \ \ Low-level output voltage \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$			1 4 4		25°C	4.25	4.65		4.25	4.65		
$V_{OL} \ \ Low-level output voltage \ \ V_{IC} = 2.5 \ V,  I_{OL} = 500 \ \mu A \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$			IOH = -1 MA		Full range	4.25			4.25			
$ V_{OL}  \text{Low-level output voltage }  V_{IC} = 2.5  \text{V},  I_{OL} = 500  \mu\text{A} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 5  \text{mA} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V},  I_{OL} = 2.5  \text{V} \\ \hline V_{IC} = 2.5  \text{V} \\ \hline$			V <sub>IC</sub> = 2.5 V,	I <sub>OL</sub> = 50 μA	25°C		0.01			0.01		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			V 25V L		25°C		0.09	0.15		0.09	0.15	
$ V_{ C } = 2.5 \text{ V},   O_{ C } = 5 \text{ mA} $ Full range	VOL	Low-level output voltage	VIC = 2.5 V, IC	ΣΓ = 200 μΑ	Full range			0.15			0.15	V
AVD			V: 2 F V	la. – E mA	25°C		0.9	1.5		0.9	1.5	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			VIC = 2.5 V,	IOC = 2 IIIA	Full range			1.5			1.5	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			.,	D. 401-0†	25°C	15	35		15	35		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	AVD			R[ = 10 K22+	Full range	15			15			V/mV
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		voltage amplification	1 10 - 1 1 10 + 1	$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	r <sub>id</sub>				25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	rį	·			25°C		1012			1012		Ω
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	ci	'	f = 10 kHz,	N package	25°C		8			8		pF
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	z <sub>O</sub>		f = 1 MHz,	A <sub>V</sub> = 10	25°C		140			140		Ω
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	OMBE	Common-mode rejection	$V_{IC} = 0 \text{ V to } 2.7 \text{ V}$		25°C	70	75		70	75		.ID
kSVR ratio ( $\Delta$ VDD/ $\Delta$ VIO) VIC = VDD/2, No load Full range 80 80 dB	CMRR				Full range	70			70			aB
ratio ( $\Delta V_{DD}/\Delta V_{IO}$ ) $V_{IC} = V_{DD}/2$ , No load Full range 80 80 dB	l	Supply-voltage rejection	V <sub>DD</sub> = 4.4 V to 1	6 V,	25°C	80	95		80	95		10
In Supply current I/o = 2.5.V No lood	KSVR				Full range	80			80			aB
Supply current $VO = 2.5 \text{ V}$ , No load Full range 6 mA	1	Committee and a state of	V- 05V	Nelect	25°C		4.4	6		4.4	6	^
	DD	Supply current	VO = 2.5 V,	ino load	Full range			6			6	mA

<sup>†</sup> 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  $T_A = 150$ °C extrapolated to  $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



<sup>‡</sup>Referenced to 0 V

## TLC2274C operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

				_ +	1	TLC22740	;	TI	_C2274A	С	
PA	RAMETER	TEST CONDI	TIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
				25°C	2.3	3.6		2.3	3.6		
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 <sub>L</sub> = 100 pF <sup>‡</sup>	Full range	1.7			1.7			V/μs
V	Equivalent input	f = 10 Hz		25°C		50			50		->4/ <del>11-</del>
Vn	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1					
VN(PP)	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			μV		
In	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	$V_O = 0.5 \text{ V to } 2.5 \text{ V},$	A <sub>V</sub> = 1			0.0013%			0.0013%		
THD + N	distortion plus	f = 20 kHz,	A <sub>V</sub> = 10	25°C		0.004%			0.004%		
	noise	$R_L = 10 \text{ k}\Omega^{\ddagger}$	A <sub>V</sub> = 100			0.03%			0.03%		
	Gain-bandwidth product	f = 10  kHz, $C_L = 100 \text{ pF}^{\ddagger}$	$R_L = 10 \text{ k}\Omega^{\ddagger}$ ,	25°C		2.18			2.18		MHz
ВОМ	Maximum output-swing bandwidth	$V_{O(PP)} = 2 \text{ V},$ $R_L = 10 \text{ k}\Omega^{\ddagger},$	A <sub>V</sub> = 1, C <sub>L</sub> = 100 pF <sup>‡</sup>	25°C		1			1		MHz
	Cattling time	$A_V = -1$ , Step = 0.5 V to 2.5 V,	To 0.1%	2500		1.5			1.5		
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	25°C		2.6			2.6		μs
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega^{\ddagger}$	C <sub>L</sub> = 100 pF‡	25°C		50°			50°		
	Gain margin	1 -	_ '	25°C		10			10		dB

<sup>†</sup> Full range is 0°C to 70°C. ‡ Referenced to 0 V



SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	PARAMETER	TEST CO	ONDITIONS	- +	Т	LC2274	С	TL	.C2274A	C	
	FARAMETER	1231 00	DINDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
VIO	Input offset voltage			25°C		300	2500		300	950	μV
V10	input onset voltage	]		Full range			3000			1500	μν
αΛΙΟ	Temperature coefficient of input offset voltage			25°C to 70°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0 V$ , $R_S = 50 \Omega$	$V_O = 0 V$ ,	25°C		0.002			0.002		μV/mo
1	Innut offeet europt	1		25°C		0.5	60		0.5	60	- A
liO	Input offset current			Full range			100			100	рA
lin	Input bias current			25°C		1	60		1	60	pА
ΙΒ	input bias current			Full range			100			100	PΑ
\/	Common-mode input	D- 50.0	N/1-1 < F ms //	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2		V
VICR	voltage	KS = 50 12,	$ V_{IO}  \le 5 \text{ mV}$	Full range	-5 to 3.5			-5 to 3.5			V
		I <sub>O</sub> = -20 μA		25°C		4.99			4.99		
			^	25°C	4.85	4.93		4.85	4.93		
VOM+	Maximum positive peak output voltage	$I_{O} = -200 \mu$	А	Full range	4.85			4.85			V
	voltago	lo - 1 m/		25°C	4.25	4.65		4.25	4.65		
		$I_O = -1 \text{ mA}$		Full range	4.25			4.25			
		$V_{IC} = 0 V$ ,	$I_O = 50 \mu A$	25°C		-4.99			-4.99		
		V 0.V	I- 500 ·· A	25°C	-4.8 5	-4.91		-4.85	-4.91		
V <sub>OM</sub> -	Maximum negative peak output voltage	V C = 0 V,	ΙΟ = 500 μΑ	Full range	-4.8 5			-4.85			V
		.,		25°C	-3.5	-4.1		-3.5	-4.1		
		VIC = 0 V	$I_O = -5 \text{ mA}$	Full range	-3.5			-3.5			
			D. 401-0	25°C	25	50		25	50		
AVD	Large-signal differential voltage amplification	V <sub>O</sub> = ±4 V	R <sub>L</sub> = 10 kΩ	Full range	25			25			V/mV
	voltage amplification		$R_L = 1 M\Omega$	25°C		300			300		
rid	Differential input resistance			25°C		1012			1012		Ω
rį	Common-mode input resistance			25°C		1012			1012		Ω
ci	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,	Ay = 10	25°C		130			130		Ω
CMDD	Common mando maio etica metic	V <sub>IC</sub> = -5 V	to 2.7 V,	25°C	75	80		75	80		40
CIVIKK	Common-mode rejection ratio	$V_0 = 0 V$	$R_S = 50 \Omega$	Full range	75			75			dB
keyre	Supply-voltage rejection ratio	V <sub>DD±</sub> = ±2.	2 V to ±8 V,	25°C	80	95		80	95		٩D
ksvr	$(\Delta V_{DD\pm}/\Delta V_{IO})$	$V_{IC} = 0 V$	No load	Full range	80			80			dB
la s	Cumply ourrant	\\o = 0.\\	No load	25°C		4.8	6		4.8	6	m ^
<sup>I</sup> DD	Supply current	$V_O = 0 V$	เพษายลติ	Full range			6			6	mA

<sup>†</sup>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.



## TLC2274C operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm5~V$

_	AD AMETED	TEOT CONDITIO		- +	Т	LC22740		Τι	_C2274A	С	
	ARAMETER	TEST CONDITIO	)NS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	<u> </u>			25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_O = \pm 2.3 \text{ V}, \qquad R_L = C_L = 100 \text{ pF}$	10 kΩ,	Full range	1.7			1.7			V/μs
.,	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ <del>Hz</del>
Vn	noise voltage	f = 1 Hz		25°C		9			9		nv/√HZ
,,	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		
VN(PP)	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	V <sub>O</sub> = ±2.3 V,	A <sub>V</sub> = 1			0.0011%			0.0011%		
THD + N	distortion plus	f = 20 kHz,	A <sub>V</sub> = 10	25°C		0.004%			0.004%		
	noise	$R_L = 10 \text{ k}\Omega$	$A_{V} = 100$			0.03%			0.03%		
	Gain-bandwidth product	f = 10 kHz, R <sub>L</sub> = 1 C <sub>L</sub> = 100 pF	10 kΩ,	25°C		2.25			2.25		MHz
B <sub>OM</sub>	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6 \text{ V},  A_{V} = R_{L} = 10 \text{ k}\Omega,  C_{L} = 0.00$	1, 100 pF	25°C		0.54			0.54		MHz
	Settling time	$A_V = -1$ , Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		
t <sub>S</sub>	Setting time	$R_L = 10 \text{ k}\Omega$ , $C_L = 100 \text{ pF}$	To 0.01%	25 0		3.2			3.2		μs
φm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega$ , $C_L =$	100 pF	25°C		52°			52°		
	Gain margin	] -	•	25°C		10			10		dB

<sup>†</sup> Full range is 0°C to 70°C.

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	DADAMETED	TEST CO.	NDITIONS		1	TLC2272		Т	LC2272A	AI .	
	PARAMETER	TEST CO	NDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V <sub>IO</sub>	Input offset voltage			25°C		300	2500		300	950	μV
۷IO	input onset voltage	]		Full range			3000			1500	μν
$\alpha_{\text{VIO}}$	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)		$V_{DD\pm} = \pm 2.5 \text{ V}$	25°C		0.002			0.002		μV/mo
		$V_O = 0 V$ ,	$R_S = 50 \Omega$	25°C		0.5	60		0.5	60	
I <sub>IO</sub>	Input offset current			-40°C to 85°C			150			150	pА
				Full range			800			800	
				25°C		1	60		1	60	
I <sub>IB</sub>	Input bias current			-40°C to 85°C			150			150	pА
				Full range			800			800	
V <sub>ICR</sub>	Common-mode input	$R_S = 50 \Omega$ ,	V <sub>IO</sub>   ≤ 5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
VICR	voltage	NS = 00 \$2,	V     3 111V	Full range	0 to 3.5			0 to 3.5			V
		$I_{OH} = -20 \mu A$		25°C		4.99			4.99		
	18.1.1	I <sub>OH</sub> = -200 μA		25°C	4.85	4.93		4.85	4.93		
$V_{OH}$	High-level output voltage	ΙΟΗ = -200 μΑ		Full range	4.85			4.85			V
	vollago	I <sub>OH</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65		
		IOH = - I IIIA		Full range	4.25			4.25			
		$V_{IC} = 2.5 V$ ,	$I_{OL} = 50 \mu A$	25°C		0.01			0.01		
	Lave lavel avitavit	V <sub>IC</sub> = 2.5 V,	I <sub>OL</sub> = 500 μA	25°C		0.09	0.15		0.09	0.15	
$V_{OL}$	Low-level output voltage	V <sub>1</sub> C = 2.0 v,	10L = 000 μ/τ	Full range			0.15			0.15	V
	3	V <sub>IČ</sub> = 2.5 V,	I <sub>OL</sub> = 5 mA	25°C		0.9	1.5		0.9	1.5	
		10 =10 1,	.OL 0	Full range			1.5			1.5	
	Large-signal differential	V <sub>IC</sub> = 2.5 V,	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	15	35		15	35		
$A_{VD}$	voltage amplification	$V_{IC} = 2.5 \text{ V},$ $V_{O} = 1 \text{ V to 4 V}$		Full range	15			15			V/mV
			$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
r <sub>id</sub>	Differential input resistance			25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω
rį	Common-mode input resistance			25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω
Ci	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		140	_		140		Ω
CMDD	Common-mode	$V_{IC} = 0 \text{ V to } 2.7$	V,	25°C	70	75		70	75		<b>4</b> D
CMRR	rejection ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	70			70			dB
k <sub>SVR</sub>	Supply-voltage rejection ratio	$V_{DD} = 4.4 \text{ V to 1}$ $V_{IC} = V_{DD}/2$ ,	6 V, No load	25°C	80	95		80	95		dB
	$(\Delta V_{DD}/\Delta V_{IO})$	VIC - VDD/Z,	างบาบสน	Full range	80			80			
Inn	Supply current	V <sub>O</sub> = 2.5 V,	No load	25°C		2.2	3		2.2	3	mA
I <sub>DD</sub>	Cappiy Carrett	v0 - 2.5 v,	140 1000	Full range			3			3	111/

<sup>†</sup> Full range is – 40°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  $T_A = 150$ °C extrapolated to  $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



<sup>‡</sup>Referenced to 0 V

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

	DAMETER	TEST CONDITION	2110	- +		TLC2272I		1	LC2272AI		
PA	ARAMETER	TEST CONDITION	ONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Olassa mata at	V 05V1-05V		25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_O = 0.5 \text{ V to } 2.5 \text{ V},$ $R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_I$	_ = 100 pF‡	Full range	1.7			1.7			V/μs
.,	Equivalent input	f = 10 Hz		25°C		50			50		nV√ <del>Hz</del>
V <sub>n</sub>	noise voltage	f = 1 kHz		25°C		9			9		nv√Hz
V	Peak-to-peak equivalent input	f = 0.1 Hz to 1 Hz		25°C		1			1		\/
V <sub>NPP</sub>	noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA√Hz
	Total harmonic	$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	A <sub>V</sub> = 1			0.0013%			0.0013%		
THD + N	distortion plus	f = 20 kHz,	$A_{V} = 10$	25°C		0.004%			0.004%		
	noise	$R_L = 10 \text{ k}\Omega^{\ddagger}$	$A_{V} = 100$			0.03%			0.03%		
	Gain-bandwidth product	$f = 10 \text{ kHz}, R_1$ $C_L = 100 \text{ pF}^{\ddagger}$	$_{-}$ = 10 k $\Omega$ <sup>‡</sup> ,	25°C		2.18			2.18		MHz
ВОМ	Maximum output- swing bandwidth		/ = 1, _ = 100 pF‡	25°C		1			1		MHz
	Settling time	$A_V = -1$ , Step = 0.5 V to 2.5 V,	To 0.1%	25°C		1.5			1.5		
t <sub>S</sub>	Setting time	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	20 0		2.6			2.6		μS
фm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega^{\ddagger},$ $C_{I}$	= 100 pF‡	25°C		50°			50°		
	Gain margin	] -	- '	25°C		10			10		dB

<sup>†</sup> Full range is – 40°C to 125°C. ‡ Referenced to 0 V

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	DADAMETED	TEST 00	NDITIONS		Т	LC2272I		TI	LC2272A		
	PARAMETER	IESI CO	NDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V <sub>IO</sub>	Input offset voltage			25°C		300	2500		300	950	μV
V10	mpat onset voltage	]		Full range			3000			1500	μν
$\alpha_{\text{VIO}}$	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0 V$ , $R_S = 50 \Omega$	V <sub>O</sub> = 0 V,	25°C		0.002			0.002		μV/mo
		1.5 00 ==		25°C		0.5	60		0.5	60	
$I_{IO}$	Input offset current			-40°C to 85°C			150			150	рА
				Full range			800			800	
		1		25°C		1	60		1	60	
I <sub>IB</sub>	Input bias current			-40°C to 85°C			150			150	рА
				Full range			800			800	
$V_{ICR}$	Common-mode	$R_S = 50 \Omega$	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
VICR	input voltage	NS = 50 22,	v 0   ≥ 3 111v	Full range	–5 to 3.5			–5 to 3.5			V
		$I_O = -20 \mu A$		25°C		4.99			4.99		
		I <sub>O</sub> = -200 μA		25°C	4.85	4.93		4.85	4.93		
$V_{OM+}$	Maximum positive peak output voltage	10 = -200 μΑ		Full range	4.85			4.85			V
	pour output romago	I <sub>O</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65		
				Full range	4.25			4.25			
		$V_{IC} = 0 V$ ,	$I_O = 50 \mu A$	25°C		-4.99			-4.99		
	Maximum negative	V <sub>IC</sub> = 0 V,	I <sub>O</sub> = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
$V_{OM-}$	peak output voltage	VIC = 0 V,	10 = 000 μ/ τ	Full range	-4.85			-4.85			V
		V <sub>IC</sub> = 0 V,	$I_O = 5 \text{ mA}$	25°C	-3.5	-4.1		-3.5	-4.1		
		10 0 1,	.0 0	Full range	-3.5			-3.5			
	Large-signal		$R_L = 10 \text{ k}\Omega$	25°C	25	50		25	50		
$A_{VD}$	differential voltage	$V_O = \pm 4 V$		Full range	25			25			V/mV
	amplification		$R_L = 1 \text{ m}\Omega$	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
Ci	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
01400	Common-mode	$V_{IC} = -5 \text{ V to } 2.7$	7 V,	25°C	75	80		75	80		
CMRR	rejection ratio		$R_S = 50 \Omega$	Full range	75			75			dB
k <sub>SVR</sub>	Supply-voltage rejection ratio	V <sub>DD</sub> = 4.4 V to 1		25°C	80	95		80	95		dB
OVIC	$(\Delta V_{DD\pm}/\Delta V_{IO})$	$V_{IC} = V_{DD}/2,$	No load	Full range	80			80			
	Cumply aver	.,	No les d	25°C		2.4	3		2.4	3	A
I <sub>DD</sub>	Supply current	$V_O = 0 V$ ,	No load	Full range			3			3	mA

<sup>†</sup> Full range is – 40°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  $T_A = 150^{\circ}C$  extrapolated to  $T_A = 25^{\circ}C$  using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

		TEGT GOVERNMENT		_ +		TLC2272I		Т	LC2272A	I	
P/	ARAMETER	TEST CONDITION	ONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Slew rate at	$V_0 = \pm 2.3 \text{ V}, R$	L = 10 kΩ,	25°C	2.3	3.6		2.3	3.6		
SR	unity gain	$C_L = 100 \text{ pF}$	L = 10 KS2,	Full range	1.7			1.7			V/μs
.,	Equivalent input	f = 10 Hz		25°C		50			50		nV√ <del>Hz</del>
V <sub>n</sub>	noise voltage	f = 1 kHz		25°C		9			9		nv√HZ
V	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		
VNPP	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA√Hz
	Total harmonic	V <sub>O</sub> = ±2.3 V	A <sub>V</sub> = 1			0.0011%			0.0011%		
THD + N	distortion plus	$R_L = 10 \text{ k}\Omega$	$A_{V} = 10$	25°C		0.004%			0.004%		
	noise	f = 20 kHz	$A_{V} = 100$			0.03%			0.03%		
	Gain-bandwidth product	f = 10 kHz, R C <sub>L</sub> = 100 pF	L = 10 kΩ,	25°C		2.25			2.25		MHz
ВОМ	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6 \text{ V},$ Average $R_L = 10 \text{ k}\Omega,$ C	v = 1, L = 100 pF	25°C		0.54			0.54		MHz
	Cattling time	$A_V = -1$ , Step = -2.3 V to 2.3 V,	To 0.1%	0500		1.5			1.5		
t <sub>S</sub>	Settling time	$R_1 = 10 \text{ kO}$	To 0.01%	25°C		3.2			3.2		μs
φm	Phase margin at unity gain	R <sub>L</sub> = 10 kΩ, C	L = 100 pF	25°C		52°	_	_	52°		
	Gain margin	]	•	25°C		10			10		dB

<sup>†</sup> Full range is –40°C to 125°C.

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	PARAMETER	TEST CON	IDITIONS	T <sub>A</sub> †	Т	LC2274	I	TI	LC2274	Al	UNIT
	FARAMETER	1E31 CON	IDITIONS	'A'	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V <sub>IO</sub>	Input offset voltage			25°C		300	2500		300	950	μV
V10	input onset voltage			Full range			3000			1500	μν
$\alpha_{VIO}$	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	V+2 E V	V0.V	25°C		0.002			0.002		μV/mc
		$V_{DD\pm} = \pm 2.5 \text{ V},$ $V_{O} = 0 \text{ V},$		25°C		0.5	60		0.5	60	
I <sub>IO</sub>	Input offset current		•	-40°C to 85°C			150			150	pА
				Full range			800			800	
		1		25°C		1	60		1	60	
I <sub>IB</sub>	Input bias current			-40°C to 85°C			150			150	pА
				Full range			800			800	
.,	Common-mode input	<b>5 50</b> 0	N/ 1 - <b>5</b> - 1/	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		.,
V <sub>ICR</sub>	voltage	$R_S = 50 \Omega$ ,	$ V_{IO}  \le 5 \text{ mV}$	Full range	0 to 3.5			0 to 3.5			V
		$I_{OH} = -20  \mu A$		25°C		4.99			4.99		
				25°C	4.85	4.93		4.85	4.93		
V <sub>OH</sub>	High-level output voltage	$I_{OH} = -200 \mu A$		Full range	4.85			4.85			V
				25°C	4.25	4.65		4.25	4.65		
		$I_{OH} = -1 \text{ mA}$		Full range	4.25			4.25			
		V <sub>IC</sub> = 2.5 V,	I <sub>OL</sub> = 50 μA	25°C		0.01			0.01		
		V 25V	I 500 A	25°C		0.09	0.15		0.09	0.15	
$V_{OL}$	Low-level output voltage	$V_{IC} = 2.5 V,$	$I_{OL} = 500 \mu\text{A}$	Full range			0.15			0.15	V
		V <sub>IC</sub> = 2.5 V,	l EmA	25°C		0.9	1.5		0.9	1.5	
		V <sub>IC</sub> = 2.5 V,	$I_{OL} = 5 \text{ mA}$	Full range			1.5			1.5	
			D 40 kgt	25°C	15	35		15	35		
$A_{VD}$	Large-signal differential voltage amplification	$V_{IC} = 2.5 \text{ V},$ $V_{O} = 1 \text{ V to 4 V}$	$R_L = 10 \text{ k}\Omega^{\ddagger}$	Full range	15			15			V/mV
	voltago amplinoation	10-1151	$R_L = 1 M\Omega^{\ddagger}$	25°C		175			175		
r <sub>id</sub>	Differential input resistance			25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω
rį	Common-mode input resistance			25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω
Ci	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		140			140		Ω
OMES	Common-mode rejection	$V_{IC} = 0 \text{ V to } 2.7 \text{ V}$	V,	25°C	70	75		70	75		i
CMRR	ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	70			70			dB
	Supply-voltage rejection	V <sub>DD</sub> = 4.4 V to 1	6 V,	25°C	80	95		80	95		
k <sub>SVR</sub>	ratio ( $\Delta V_{DD} / \Delta V_{IO}$ )	$V_{IC} = V_{DD}/2,$	No load	Full range	80			80			dB
	Comply compart	V 25V	No loo-l	25°C		4.4	6		4.4	6	A
I <sub>DD</sub>	Supply current	$V_{O} = 2.5 \text{ V},$	No load	Full range			6			6	mA

<sup>†</sup> Full range is – 40°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  $T_A = 150^{\circ}C$  extrapolated to  $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



<sup>‡</sup>Referenced to 0 V

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

		TEGT CONDITI	0110	_ +		TLC22741		Т	LC2274A	J	
	PARAMETER	TEST CONDITI	ONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	01	V 05V 05V		25°C	2.3	3.6		2.3	3.6		
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 pF‡	Full range	1.7			1.7			V/μs
	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ <del>Hz</del>
Vn	noise voltage	f = 1 kHz		25°C		9			9		nv/√HZ
	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		V
V <sub>N(PP)</sub>	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
		$V_O = 0.5 \text{ V to } 2.5 \text{ V},$	A <sub>V</sub> = 1			0.0013%			0.0013%		
THD + N	Total harmonic distortion plus noise	f = 20 kHz,	A <sub>V</sub> = 10	25°C		0.004%			0.004%		
	allotoratori prao riolog	$R_L = 10 \text{ k}\Omega^{\ddagger}$	$A_{V} = 100$			0.03%			0.03%		
	Gain-bandwidth product	$f = 10 \text{ kHz}, R_L = C_L = 100 \text{ pF}^{\ddagger}$	10 kΩ <sup>‡</sup> ,	25°C		2.18			2.18		MHz
ВОМ	Maximum output-swing bandwidth	$V_{O(PP)} = 2 \text{ V},  A_{V} = R_{L} = 10 \text{ k}\Omega^{\ddagger},  C_{L} = 0$	1, 100 pF <sup>‡</sup>	25°C		1			1		MHz
4	Cattling time	$A_V = -1$ , Step = 0.5 V to 2.5 V,	To 0.1%	25°C		1.5			1.5		
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	25 0		2.6			2.6		μs
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega^{\ddagger},  C_{I} =$	100 pF <sup>‡</sup>	25°C		50°			50°		
	Gain margin	$R_L = 10 \text{ k}\Omega^{\ddagger},  C_L = 100 \text{ pF}^{\ddagger}$		25°C		10			10		dB

<sup>†</sup> Full range is – 40°C to 125°C. ‡ Referenced to 0 V

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

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

	PARAMETER	TEST CO	ONDITIONS		T	LC2274I		TI	LC2274A	I	UNIT
	PARAMETER	IESI CO	CHOITIUNS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNII
V <sub>IO</sub>	Input offset voltage			25°C		300	2500		300	950	μV
۷IO	input onset voltage			Full range			3000			1500	μν
αΛΙΟ	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	V <sub>IC</sub> = 0 V,	V 0 V	25°C		0.002			0.002		μV/mo
		$R_S = 50 \Omega$	ν <sub>O</sub> = 0 ν,	25°C		0.5	60		0.5	60	
I <sub>IO</sub>	Input offset current			-40°C to 85°C			150			150	pА
				Full range			800			800	
		1		25°C		1	60		1	60	
$I_{IB}$	Input bias current			-40°C to 85°C			150			150	pA
				Full range			800			800	
V	Common-mode input	B 50.0	\\ \< \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	25°C	-5 to 4	-5.3 to 4.2		–5 to 4	-5.3 to 4.2		V
V <sub>ICR</sub>	voltage	$R_{\rm S} = 50  \Omega_{\rm S}$	$ V_{IO}  \le 5 \text{ mV}$	Full range	–5 to 3.5			–5 to 3.5			V
		$I_{O} = -20 \mu A$		25°C		4.99			4.99		
			^	25°C	4.85	4.93		4.85	4.93		
V <sub>OM+</sub>	Maximum positive peak output voltage	$I_{O} = -200 \mu$	A	Full range	4.85			4.85			V
	output ronage	l - 1 mΛ		25°C	4.25	4.65		4.25	4.65		
		$I_O = -1 \text{ mA}$		Full range	4.25			4.25			
		$V_{IC} = 0 V$ ,	I <sub>O</sub> = 50 μA	25°C		-4.99			-4.99		
		V.a = 0 V	I <sub>O</sub> = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
$V_{OM-}$	Maximum negative peak output voltage	VIC = 0 V,	10 = 300 μΑ	Full range	-4.85			-4.85			V
		V <sub>IC</sub> = 0 V,	lo = 5 mΛ	25°C	-3.5	-4.1		-3.5	-4.1		
		VIC = 0 V,	10 = 3 1112	Full range	-3.5			-3.5			
	Lorgo signal differential		$R_L = 10 \text{ k}\Omega$	25°C	25	50		25	50		
$A_{VD}$	Large-signal differential voltage amplification	$V_0 = \pm 4 V$	NC = 10 K22	Full range	25			25			V/m\
			$R_L = 1 M\Omega$	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
Ci	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	$V_{IC} = -5 V t$		25°C	75	80		75	80		٩D
CIVIRK	ratio	$V_0 = 0 V$ ,	$R_S = 50 \Omega$	Full range	75			75			dB
l,	Supply-voltage rejection	$V_{DD\pm} = \pm 2.2$	2 V to ±8 V,	25°C	80	95		80	95		Ļ
k <sub>SVR</sub>	ratio $(\Delta V_{DD\pm}/\Delta V_{IO})$	$V_{IC} = 0 V$ ,	No load	Full range	80			80			dB
ı	Supply current	V -0V	No load	25°C		4.8	6		4.8	6	^
I <sub>DD</sub>	Supply current	urrent $V_{\odot} = 0 \text{ V}$ , No load	V, No load	Full range			6	_		6	mA

<sup>†</sup> Full range is – 40°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  $T_A = 150$ °C extrapolated to  $T_A = 25$ °C using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

		TEGT COMPLETE		_ +		TLC22741		Т	LC2274A	I	
"	ARAMETER	TEST CONDITION	ONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	01	у	4010	25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_{O} = \pm 2.3 \text{ V},$ $C_{L} = 100 \text{ pF}$	L = 10 kΩ,	Full range	1.7			1.7			V/μs
.,	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ <del>Hz</del>
V <sub>n</sub>	noise voltage	f = 1 kHz		25°C		9			9		nv/√Hz
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		.,
V <sub>N(PP)</sub>	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	$V_{O} = \pm 2.3 \text{ V},$	A <sub>V</sub> = 1			0.0011%			0.0011%		
THD + N	distortion plus	$R_L = 10 \text{ k}\Omega$	A <sub>V</sub> = 10	25°C		0.004%			0.004%		
	noise	f = 20 kHz	A <sub>V</sub> = 100			0.03%			0.03%		
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $C_L = 100 \text{ pF}$	L = 10 kΩ,	25°C		2.25			2.25		MHz
B <sub>OM</sub>	Maximum output- swing bandwidth		y = 1, L = 100 pF	25°C		0.54			0.54		MHz
	Cattling time	$A_V = -1$ , Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		
t <sub>S</sub>	Settling time	$R_L$ = 10 kΩ, $C_L$ = 100 pF	To 0.01%	25°C		3.2			3.2		μS
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega,$ $C_{I}$	ı = 100 pF	25°C		52°			52°		
	Gain margin	]	- '	25°C		10			10		dB

<sup>†</sup> Full range is –40°C to 125°C.

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

# TLC2272Q and TLC2272M electrical characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$ (unless otherwise noted)

	PARAMETER	TEST CO	NDITIONS	T <sub>A</sub> †		LC22720 LC2272		TLC2272AQ, TLC2272AM  MIN TYP MAX  300 950  1500  2  0.002  0.5 60  800  1 60  800  0 -0.3 to 4 to 4.2  0 to 3.5  4.99  4.85  4.93  4.85  4.25  0.01  0.09  0.15  0.05  1.5  1.5	UNIT		
_					MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>IO</sub> I	Input offset voltage			25°C		300	2500		300	950	μV
VIO 1	input onset voltage			Full range			3000			1500	μν
	Temperature coefficient of input offset voltage			25°C to 125°C		2			2		μV/°C
	Input offset voltage long- term drift (see Note 4)	$V_{IC} = 0 V$ , $V_{O} = 0 V$ ,	$V_{DD\pm} = \pm 2.5 \text{ V},$ R <sub>S</sub> = 50 $\Omega$	25°C		0.002			0.002		μV/mo
ا ما	Input offeet ourrent		_	25°C		0.5	60		0.5	60	- Δ
IIO I	Input offset current			Full range			800			800	рA
	lanut biog gurrant			25°C		1	60		1	60	<b>π</b> Λ
IIB I	Input bias current			Full range			800			800	рA
V:05 (	Common-mode input	Po - 50 O	\/.o.  < 5 m\/	25°C	0 to 4	-0.3 to 4.2					V
	voltage	$R_S = 50 \Omega$ ,	$ V_{IO}  \le 5 \text{ mV}$	Full range	0 to 3.5			-			ľ
		$I_{OH} = -20  \mu A$		25°C		4.99			4.99		
				25°C	4.85	4.93		4.85	4.93		
\/ \	High-level output voltage	$I_{OH} = -200 \mu\text{A}$		Full range	4.85			4.85			V
,	voltage	1 4 4		25°C	4.25	4.65		4.25	4.65		
		$I_{OH} = -1 \text{ mA}$		Full range	4.25			4.25			
		V <sub>IC</sub> = 2.5 V,	I <sub>OL</sub> = 50 μA	25°C		0.01			0.01		
		V:- 2.5.V	In. 500 A	25°C		0.09	0.15		0.09	0.15	
V <sub>OL</sub> L	Low-level output voltage	$V_{IC} = 2.5 V,$	I <sub>OL</sub> = 500 μA	Full range			0.15			0.15	V
		V <sub>IC</sub> = 2.5 V,	lot – E mA	25°C		0.9	1.5		0.9	1.5	
		VIC = 2.5 V,	I <sub>OL</sub> = 5 mA	Full range			1.5			1.5	
ı	Large-signal	., 0.5.7	R <sub>L</sub> = 10 kΩ <sup>‡</sup>	25°C	10	35		10	35		
	differential voltage	$V_{IC} = 2.5 \text{ V},$ $V_{O} = 1 \text{ V to 4 V}$		Full range	10			10			V/mV
	amplification	VO = 1 V 10 4 V	$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
	Differential input resistance			25°C		10 <sup>12</sup>			1012		Ω
r:	Common-mode input resistance			25°C		1012			1012		Ω
C:	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8			8		pF
	Closed-loop output impedance	f = 1 MHz,	A <sub>V</sub> = 10	25°C		140			140		Ω
OMES (	Common-mode rejection	V <sub>IC</sub> = 0 V to 2.7	V,	25°C	70	75		70	75		.15
UNKK	ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	70			70			dB
lk	Supply-voltage rejection	V <sub>DD</sub> = 4.4 V to 1	6 V,	25°C	80	95		80	95		40
	ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> )	$V_{IC} = V_{DD}/2$	No load	Full range	80			80			dB
	0	V 05V	No. local	25°C		2.2	3		2.2	3	
IDD S	Supply current	$V_0 = 2.5 V$ ,	No load	Full range			3			3	mA

Full range is –40°C to 125°C for Q level part, –55°C to 125°C for M level part.

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



<sup>‡</sup>Referenced to 2.5 V

## TLC2272Q and TLC2272M operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

P#	ARAMETER	TEST CONDITION	ONS	T <sub>A</sub> †		LC22720	,		.C2272A( .C2272A)	,	UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
	0	V 4.05.V/ 0.75.V/		25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_{O} = 1.25 \text{ V to } 2.75 \text{ V},$ $R_{L} = 10 \text{ k}\Omega^{\ddagger},$ $C_{L} = 10 \text{ k}\Omega^{\ddagger}$	= 100 pF‡	Full range	1.7			1.7			V/µs
.,	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ <del>Hz</del>
Vn	noise voltage	f = 1 kHz		25°C		9			9		nv/√HZ
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		.,
VNPP	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
In	Equivalent input noise current			25°C		0.6			0.6		fA/√ <del>Hz</del>
	Total harmonic	$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	A <sub>V</sub> = 1			0.0013%			0.0013%		
THD + N	distortion plus	f = 20 kHz,	Ay = 10	25°C		0.004%			0.004%		
	noise	$R_L = 10 \text{ k}\Omega^{\ddagger}$ ,	$A_V = 100$			0.03%			0.03%		
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $C_L = 100 \text{ pF}^{\ddagger}$	_ = 10 kΩ <sup>‡</sup> ,	25°C		2.18			2.18		MHz
B <sub>OM</sub>	Maximum output- swing bandwidth		/ = 1, _ = 100 pF <sup>‡</sup>	25°C		1			1		MHz
	Cattling time	$A_V = -1$ , Step = 0.5 V to 2.5 V,	To 0.1%	25°C		1.5			1.5		
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	25 0		2.6			2.6		μs
фm	Phase margin at unity gain	R <sub>L</sub> = 10 kΩ <sup>‡</sup> , C <sub>l</sub>	= 100 pF‡	25°C		50°			50°		
	Gain margin		- '	25°C		10			10		dB

<sup>†</sup> Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.

<sup>‡</sup>Referenced to 2.5 V

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

# TLC2272Q and TLC2272M electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5$ V (unless otherwise noted)

	PARAMETER	TEST C	ONDITIONS	T <sub>A</sub> †		LC22720 LC22721			C2272A C2272A		UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
\/.0	Input offset voltage			25°C		300	2500		300	950	μV
VIO	Input offset voltage	]		Full range			3000			1500	μν
αΛΙΟ	Temperature coefficient of input offset voltage			25°C to 125°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0 V,$ $R_S = 50 \Omega$	V <sub>O</sub> = 0 V,	25°C		0.002			0.002		μV/mo
IIO	Input offset current			25°C		0.5	60		0.5	60	рA
10	input onset ourient			Full range			800			800	P/ ι
I <sub>IB</sub>	Input bias current			25°C		1	60		1	60	pА
,ID	mpat blad darront			Full range			800			800	P/ (
VICR	Common-mode input	$R_S = 50 \Omega$ ,	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
VICK	voltage	113 - 00 22,	[VIO] = 0 IIIV	Full range	-5 to 3.5			-5 to 3.5			v
		$I_O = -20 \mu A$		25°C		4.99			4.99		
	Marrian una manteixa mante	$I_{O} = -200 \mu$		25°C	4.85	4.93		4.85	4.93		
V <sub>OM+</sub>	Maximum positive peak output voltage	$10 = -200  \mu$	1	Full range	4.85			4.85			V
	output voltago	I <sub>O</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65		
		10 = -111114		Full range	4.25			4.25			
		$V_{IC} = 0 V$	$I_O = 50 \mu A$	25°C		-4.99			-4.99		
	Maximum negative peak	V <sub>IC</sub> = 0 V,	ΙΟ = 500 μΑ	25°C	-4.85	-4.91		-4.85	-4.91		
$^{V}OM-$	output voltage	VIC = 0 V,	10 = 000 μ/ ι	Full range	-4.85			-4.85			V
		V <sub>IC</sub> = 0 V,	$I_O = 5 \text{ mA}$	25°C	-3.5	-4.1		-3.5	-4.1		
		VIC = 0 V,	10 = 0 11#1	Full range	-3.5			-3.5			
	Large-signal differential		R <sub>L</sub> = 10 kΩ	25°C	20	50		20	50		
AVD	voltage amplification	$V_0 = \pm 4 V$		Full range	20			20			V/mV
			$R_L = 1 \text{ m}\Omega$	25°C		300			300		
<sup>r</sup> id	Differential input resistance			25°C		1012			1012		Ω
rį	Common-mode input resistance			25°C		1012			1012		Ω
cį	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	$V_{IC} = -5 V to$		25°C	75	80		75	80		dB
CIVIRR	ratio	$V_O = 0 V$	$R_S = 50 \Omega$	Full range	75			75			uБ
kovo	Supply-voltage rejection	V <sub>DD</sub> = ±2.2 \	√ to ±8 V,	25°C	80	95		80	95		dB
ksvr	ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{IC} = 0 V$	No load	Full range	80			80			ub
loo	Supply current	V <sub>O</sub> = 2.5 V,	No load	25°C		2.4	3		2.4	3	mΛ
I <sub>DD</sub>	Supply current	ν <sub>O</sub> = 2.5 ν,	INU IUaU	Full range		_	3		_	3	mA

<sup>†</sup> Full range is  $-40^{\circ}$ C to 125°C for Q level part,  $-55^{\circ}$ C to 125°C for M level part.

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.



# TLC2272Q and TLC2272M operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

PARAMETER		TEST CONDITIONS		T <sub>A</sub> †	TLC2272Q, TLC2272M			TLC2272AQ, TLC2272AM			UNIT	
					MIN	TYP	MAX	MIN TYP MAX				
	01	V 14.V 5	4010	25°C	2.3	3.6		2.3	3.6			
SR	Slew rate at unity gain	$V_O = \pm 1 \text{ V},$ $R_L = 10 \text{ k}\Omega,$ $C_L = 100 \text{ pF}$		Full range	1.7			1.7			V/μs	
.,	Equivalent input	f = 10 Hz		25°C		50			50		->//\ <del>  =</del>	
V <sub>n</sub>	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz	
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz f = 0.1 Hz to 10 Hz		25°C		1			1			
V <sub>NPP</sub>	equivalent input noise voltage			25°C	1.4			1.4			μV	
In	Equivalent input noise current			25°C	0.6		0.6			fA/√Hz		
	Total harmonic distortion plus noise	$V_O = \pm 2.3 \text{ V}$ $R_L = 10 \text{ k}\Omega$ , $f = 20 \text{ kHz}$	A <sub>V</sub> = 1		0.0011%				0.0011%			
THD + N			A <sub>V</sub> = 10	25°C	0.004%				0.004%			
			A <sub>V</sub> = 100		0.03%				0.03%			
	Gain-bandwidth product	f = 10 kHz, C <sub>L</sub> = 100 pF	$R_L = 10 \text{ k}\Omega$ ,	25°C	2.25		2.25			MHz		
B <sub>OM</sub>	Maximum output-swing bandwidth	V <sub>O</sub> (PP) = 4.6 V, R <sub>L</sub> = 10 kΩ,	A <sub>V</sub> = 1, C <sub>L</sub> = 100 pF	25°C	0.54		0.54		0.54			MHz
	Cattling time	$A_V = -1$ , Step = -2.3 V to 2.3 V,	To 0.1%	0500	1.5 1.5							
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega$ , $C_L = 100 \text{ pF}$	To 0.01%	25°C		3.2			3.2		μS	
фm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega$	C <sub>I</sub> = 100 pF	25°C	52°		52°					
	Gain margin		p.	25°C	10		10			dB		

<sup>†</sup> Full range is –40°C to 125°C for Q level part, –55°C to 125°C for M level part.

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

# TLC2274Q and TLC2274M electrical characteristics at specified free-air temperature, $V_{DD}$ = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T <sub>A</sub> †	TLC2274Q, TLC2274M			TLC2274AQ, TLC2274AM			UNIT	
					MIN	TYP	MAX	MIN	TYP	MAX		
1/1-2	Innut offset voltage			25°C		300	2500		300	950	\/	
VIO	Input offset voltage			Full range			3000			1500	μV	
ανιο	Temperature coefficient of input offset voltage			25°C to 125°C		2			2		μV/°C	
	Input offset voltage long-term drift (see Note 4)	$V_{DD\pm} = \pm 2.5 \text{ V},$ $V_{O} = 0 \text{ V},$	$V_{IC} = 0 V$ , $R_S = 50 \Omega$	25°C		0.002			0.002		μV/mo	
IIO	Input offset current			25°C		0.5	60		0.5	60	pА	
10	input onset current			Full range			800			800	PΛ	
I <sub>IB</sub>	Input bias current			25°C		1	60		1	60	рA	
'IB	input blub building			Full range			800			800	Pr	
Vion	Common-mode input	$R_S = 50 \Omega$	V <sub>IO</sub>   ≤ 5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V	
VICR voltage	voltage	NS = 30 22,	v O	Full range	0 to 3.5			0 to 3.5			v	
	High-level output voltage	$I_{OH} = -20 \mu A$		25°C		4.99			4.99			
		I <sub>OH</sub> = -200 μA		25°C	4.85	4.93		4.85	4.93		٧	
∨он				Full range	4.85			4.85				
		I <sub>OH</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65			
				Full range	4.25			4.25				
	Low-level output voltage	$V_{IC} = 2.5 V,$	$I_{OL} = 50 \mu\text{A}$	25°C		0.01			0.01			
		$V_{IC} = 2.5 V$ ,		25°C		0.09	0.15		0.09	0.15		
VOL		I <sub>OL</sub> = 500 μA		Full range			0.15			0.15	V	
		V <sub>IC</sub> = 2.5 V,	I <sub>OL</sub> = 5 mA	25°C		0.9	1.5		0.9	1.5		
				Full range			1.5			1.5		
	Large-signal differential voltage amplification	V <sub>IC</sub> = 2.5 V, V <sub>O</sub> = 1 V to 4 V	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	10	35		10	35		V/mV	
AVD				Full range	10			10				
		0	$R_L = 1 M\Omega^{\ddagger}$	25°C		175			175			
rid	Differential input resistance			25°C		1012			1012		Ω	
rį	Common-mode input resistance			25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω	
ci	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF	
z <sub>0</sub>	Closed-loop output impedance	f = 1 MHz,	A <sub>V</sub> = 10	25°C		140			140		Ω	
CMRR	Common-mode	V <sub>IC</sub> = 0 V to 2.7 \		25°C	70	75		70	75		dB	
	rejection ratio	V <sub>O</sub> = 2.5 V,	$R_S = 50 \Omega$	Full range	70			70	0.5			
ksvr	Supply-voltage rejection	$V_{DD} = 4.4 \text{ V to } 10^{-10}$		25°C	80	95		80	95		dB	
	ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> )	$V_{IC} = V_{DD}/2,$	No load	Full range	80	4 4		80	4.4		45	
I <sub>DD</sub>	Supply current	$V_0 = 2.5 V$ ,	No load	25°C		4.4	6		4.4	6	mA	
Ļ				Full range			6			6		

<sup>†</sup> Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.

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.



<sup>‡</sup>Referenced to 2.5 V

## TLC2274Q and TLC2274M operating characteristics at specified free-air temperature, $V_{DD} = 5 \text{ V}$

PARAMETER		TEST CONDITIONS		T <sub>A</sub> †	TLC2274Q, TLC2274M			TLC2274AQ, TLC2274AM			UNIT				
					MIN	MIN TYP MAX		MIN TYP MAX							
	Class rate at socies	V- 05 V+ 05 V	C: 400 = E‡	25°C	2.3	3.6		2.3	3.6						
SR	Slew rate at unity gain	$V_O = 0.5 \text{ V to } 2.5 \text{ V},$ $R_L = 10 \text{ k}\Omega^{\ddagger},$	CL = 100 pr+	Full range	1.7			1.7			V/µs				
.,	Equivalent input	f = 10 Hz		25°C		50			50		->///				
Vn	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz				
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz f = 0.1 Hz to 10 Hz		25°C		1			1		,				
V <sub>N(PP)</sub>	equivalent input noise voltage			25°C	1.4			1.4			μV				
In	Equivalent input noise current			25°C	0.6		0.6			fA/√Hz					
	Total harmonic distortion plus noise	$V_O$ = 0.5 V to 2.5 V, f = 20 kHz, $R_L$ = 10 k $\Omega^{\ddagger}$	A <sub>V</sub> = 1		0.0013%			0.0013%							
THD + N			A <sub>V</sub> = 10	25°C	0.004%				0.004%						
			A <sub>V</sub> = 100		0.03%				0.03%						
	Gain-bandwidth product	f = 10 kHz, C <sub>L</sub> = 100 pF <sup>‡</sup>	$R_L = 10 \text{ k}\Omega^{\ddagger}$ ,	25°C	2.18		2.18			MHz					
B <sub>OM</sub>	Maximum out- put-swing band- width	$V_{O(PP)} = 2 \text{ V},$ $R_{L} = 10 \text{ k}\Omega^{\ddagger},$	A <sub>V</sub> = 1, C <sub>L</sub> = 100 pF‡	25°C	1		1		1		1		1		MHz
	Cattling time	$A_V = -1$ , Step = 0.5 V to 2.5 V,	To 0.1%	25°C		1.5		1.5							
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	25°C		2.6			2.6		μs				
φm	Phase margin at unity gain	$R_{I} = 10 \text{ k}\Omega^{\ddagger}$	C <sub>L</sub> = 100 pF <sup>‡</sup>	25°C	50°		50° 50°								
	Gain margin	] -		25°C		10			10		dB				

 $<sup>^{\</sup>dagger}$  Full range is  $-40^{\circ}\text{C}$  to 125°C for Q level part,  $-55^{\circ}\text{C}$  to 125°C for M level part.  $^{\ddagger}$  Referenced to 2.5 V

SLOS190G - FEBRUARY 1997 - REVISED MAY 2004

# TLC2274Q and TLC2274M electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		τ <sub>Α</sub> †	TLC2274Q, TLC2274M			TLC2274AQ, TLC2274AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
\/	lanut effect veltere			25°C		300	2500		300	950	
VIO	Input offset voltage			Full range			3000			1500	μV
αΝΙΟ	Temperature coefficient of input offset voltage			25°C to 125°C		2			2		μV/°C
	Input offset voltage long- term drift (see Note 4)	$V_{IC} = 0 V$ , $R_S = 50 \Omega$	$V_O = 0 V$ ,	25°C		0.002			0.002		μV/mo
	land offers and	]		25°C		0.5	60		0.5	60	0
lio	Input offset current			Full range			800			800	pА
1	Innut bigg gurrent			25°C		1	60		1	60	n ^
IB	Input bias current			Full range			800			800	рA
\/	Common-mode input	Pa - 50 O	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
VICR	voltage	KS = 50 12,	IAIO I ≥ 2 IIIA	Full range	-5 to 3.5			-5 to 3.5			·
	Maximum positive peak output voltage	$I_{O} = -20 \mu\text{A}$		25°C		4.99			4.99		
		I <sub>O</sub> = -200 μA		25°C	4.85	4.93		4.85	4.93		
VOM+				Full range	4.85			4.85			V
		I <sub>O</sub> = -1 mA		25°C	4.25	4.65		4.25	4.65		
				Full range	4.25			4.25			
	Maximum negative peak output voltage	$V_{IC} = 0 V$	$I_{O} = 50  \mu A$	25°C		-4.99			-4.99		
		V <sub>IC</sub> = 0 V,	ΙΟ = 500 μΑ	25°C	-4.85	-4.91		-4.85	-4.91		
VoM−				Full range	-4.85			-4.85			V
		V <sub>IC</sub> = 0 V,	I <sub>O</sub> = 5 mA	25°C	-3.5	-4.1		-3.5	-4.1		
				Full range	-3.5			-3.5			
	Lanca signal differential		R <sub>L</sub> = 10 kΩ	25°C	20	50		20	50		V/mV
AVD	Large-signal differential voltage amplification	$V_0 = \pm 4 V$		Full range	20			20			
			$R_L = 1 M\Omega$	25°C		300			300		
rid	Differential input resistance			25°C		1012			1012		Ω
ri	Common-mode input resistance			25°C		10 <sup>12</sup>			10 <sup>12</sup>		Ω
ci	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z <sub>0</sub>	Closed-loop output impedance	f = 1 MHz,	A <sub>V</sub> = 10	25°C		130			130		Ω
01/55	Common-mode rejection	V <sub>IC</sub> = -5 V	to 2.7 V	25°C	75	80		75	80		15
CMRR	ratio	$V_{O} = 0 V,$	$R_S = 50 \Omega$	Full range	75			75			dB
1.	Supply-voltage rejection	V <sub>DD+</sub> = ± 2	.2 V to ±8 V,	25°C	80	95		80	95		dB
ksvr	ratio ( $\Delta V_{DD\pm}/\Delta V_{IO}$ )	$V_{IC} = 0 \text{ V},$	No load	Full range	80			80			
la e	Cupply ourront	\	No lood	25°C		4.8	6		4.8	6	
lDD	Supply current	$V_O = 0 V$ ,	No load	Full range			6			6	mA

<sup>†</sup> Full range is –40°C to 125°C for Q level part, –55°C to 125°C for M level part.

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.



# TLC2274Q and TLC2274M operating characteristics at specified free-air temperature, $V_{DD\pm}$ = $\pm 5~V$

PARAMETER		TEST CONDITIONS		T <sub>A</sub> †	TLC2274Q, TLC2274M		TLC2274AQ, TLC2274AM			UNIT	
					MIN	TYP	MAX	MIN	TYP	MAX	
	Olassa and a street to	V 100V B	401-0	25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_{O} = \pm 2.3 \text{ V},$ $R_{L} = 10 \text{ k}\Omega,$ $C_{L} = 100 \text{ pF}$		Full range	1.7			1.7			V/μs
.,	Equivalent input	f = 10 Hz		25°C		50			50		->4/15
v <sub>n</sub>	noise voltage	f = 1 kHz		25°C		9		9			nV/√Hz
.,	Peak-to-peak	f = 0.1 Hz to 1 Hz f = 0.1 Hz to 10 Hz		25°C		1			1		
V <sub>N(PP)</sub>	equivalent input noise voltage			25°C	1.4			1.4			μV
In	Equivalent input noise current			25°C	0.6		0.6			fA/√Hz	
	Total harmonic distortion plus noise	$V_{O} = \pm 2.3 \text{ V},$	A <sub>V</sub> = 1		0.0011%				0.0011%		
THD + N		$R_L = 10 \text{ k}\Omega$ , f = 20  kHz	A <sub>V</sub> = 10	25°C	0.004%				0.004%		
			A <sub>V</sub> = 100			0.03%			0.03%		
	Gain-bandwidth product	$f = 10 \text{ kHz},$ $R_L = 100 \text{ pF}$	= 10 kΩ,	25°C		2.25		2.2			MHz
B <sub>OM</sub>	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6 \text{ V},  \text{AV} = 10 \text{ k}\Omega,  \text{C}_{L} = 10 \text{ K}\Omega$	= 1, = 100 pF	25°C	0.54		0.54		0.54		MHz
	Cattling times	$A_V = -1$ , Step = -2.3 V to 2.3 V,	To 0.1%	0500		1.5		1.5 3.2			
t <sub>S</sub>	Settling time	$R_L = 10 \text{ k}\Omega$ , $C_L = 100 \text{ pF}$	To 0.01%	25°C		3.2					μS
фm	Phase margin at unit gain	$R_{I} = 10 \text{ k}\Omega$ , $C_{I}$ :				52°			52°		
	Gain margin	] - ' - '	·	25°C		10			10		dB

<sup>†</sup> Full range is –40°C to 125°C for Q level part, –55°C to 125°C for M level part.

#### **Table of Graphs**

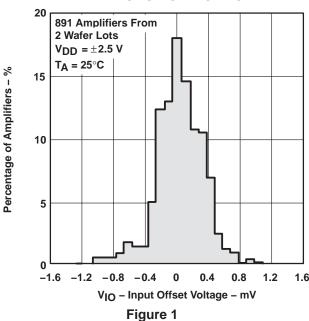
			FIGURE			
V <sub>IO</sub>	Input offset voltage	Distribution vs Common-mode voltage	1 <b>- 4</b> 5, 6			
ανιο	Input offset voltage temperature coefficient	Distribution	7 – 10			
I <sub>IB</sub> /I <sub>IO</sub>	Input bias and input offset current	vs Free-air temperature	11			
VI	Input voltage	vs Supply voltage vs Free-air temperature	12 13			
Vон	High-level output voltage	vs High-level output current	14			
VOL	Low-level output voltage	vs Low-level output current	15, 16			
V <sub>OM+</sub>	Maximum positive peak output voltage	vs Output current	17			
V <sub>OM</sub> -	Maximum negative peak output voltage	vs Output current	18			
V <sub>O(PP)</sub>	Maximum peak-to-peak output voltage	vs Frequency	19			
los	Short-circuit output current	vs Free-air temperature				
VO	Output voltage	vs Differential input voltage	22, 23			
	Large-signal differential voltage amplification	vs Load resistance	24			
$A_{VD}$	Large-signal differential voltage amplification and phase margin	vs Frequency	25, 26			
	Large-signal differential voltage amplification	vs Free-air temperature	27, 28			
z <sub>o</sub>	Output impedance	vs Frequency	29, 30			
CMRR	Common-mode rejection ratio	vs Frequency vs Free-air temperature	31 32			
ksvr	Supply-voltage rejection ratio	vs Frequency vs Free-air temperature	33, 34 35			
I <sub>DD</sub>	Supply current	vs Supply voltage vs Free-air temperature	36, 37 38, 39			
SR	Slew rate	vs Load capacitance vs Free-air temperature	40 41			
	Inverting large-signal pulse response		42, 43			
	Voltage-follower large-signal pulse response		44, 45			
VO	Inverting small-signal pulse response		46, 47			
	Voltage-follower small-signal pulse response		48, 49			
V <sub>n</sub>	Equivalent input noise voltage	vs Frequency	50, 51			
	Noise voltage over a 10-second period		52			
	Integrated noise voltage	vs Frequency	53			
THD + N	Total harmonic distortion plus noise	vs Frequency	54			
	Gain-bandwidth product	vs Supply voltage vs Free-air temperature	55 56			
φm	Phase margin	vs Load capacitance	57			
	Gain margin	vs Load capacitance	58			

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



Percentage of Amplifiers - %

## DISTRIBUTION OF TLC2272 INPUT OFFSET VOLTAGE



# DISTRIBUTION OF TLC2272 INPUT OFFSET VOLTAGE

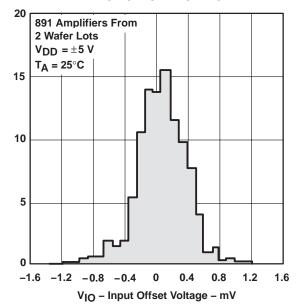


Figure 2

#### DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE

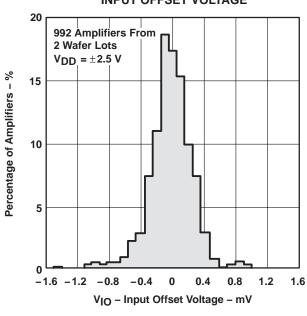


Figure 3

# DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE

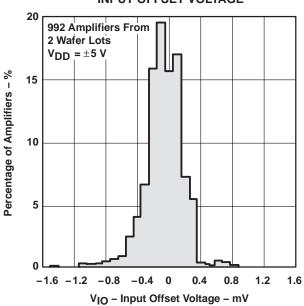


Figure 4

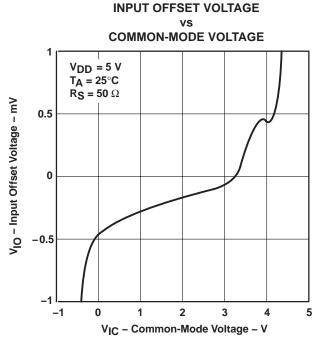


Figure 5

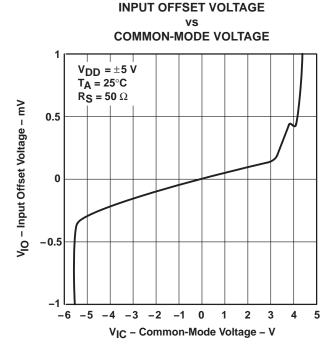


Figure 6

## **DISTRIBUTION OF TLC2272** INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT<sup>†</sup>

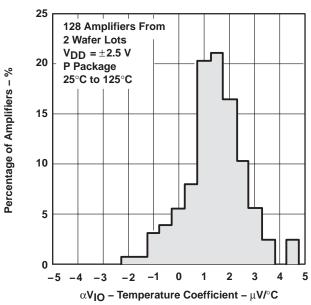


Figure 7

## **DISTRIBUTION OF TLC2272** INPUT OFFSET VOLTAGE TEMPERATURE **COEFFICIENT**†

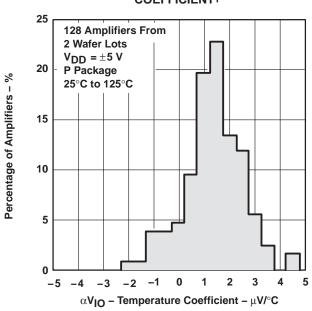


Figure 8

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



#### **DISTRIBUTION OF TLC2274** INPUT OFFSET VOLTAGE TEMPERATURE **COEFFICIENT**† 25 128 Amplifiers From 2 Wafer Lots $V_{DD} = \pm 2.5 \text{ V}$ 20 N Package Percentage of Amplifiers - % $T_A = 25^{\circ}C$ to $125^{\circ}C$ 15 10 5 2 -5 -2 -1 0 3 5 $\alpha_{\text{VIO}}$ – Temperature Coefficient – $\mu$ V/°C

Figure 9

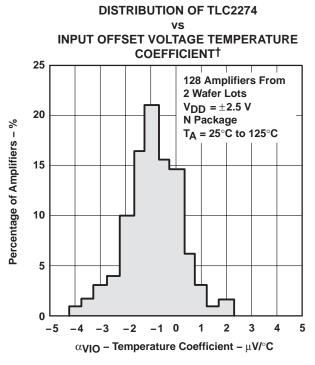
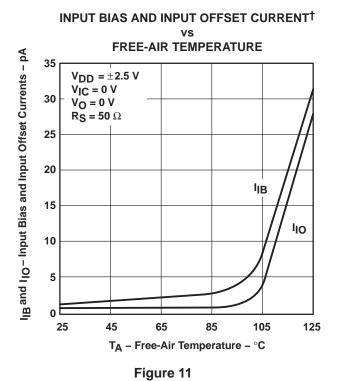
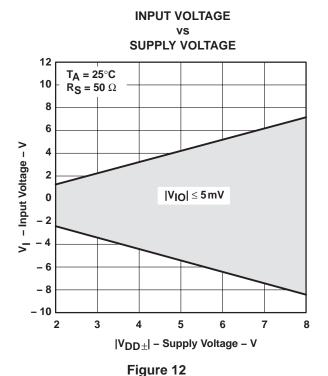


Figure 10





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



V<sub>OH</sub> - High-Level Output Voltage - V

0

0

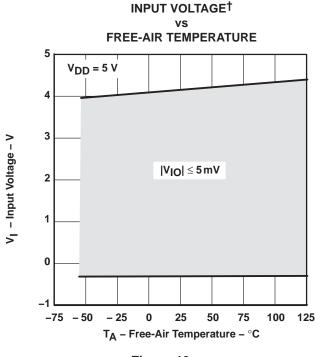
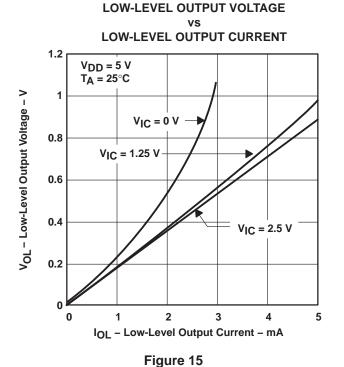
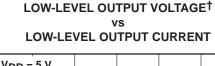


Figure 13



HIGH-LEVEL OUTPUT VOLTAGE<sup>†</sup> **HIGH-LEVEL OUTPUT CURRENT**  $V_{DD} = 5 V$  $T_A = 125^{\circ}C$  $T_A = 25^{\circ}C$  $T_A = -55^{\circ}C$ 

Figure 14



2

IOH - High-Level Output Current - mA

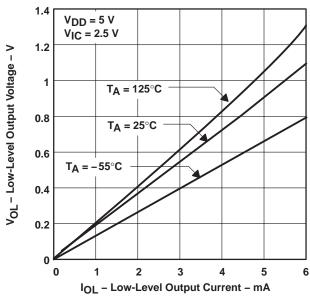


Figure 16

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



MAXIMUM NEGATIVE PEAK OUTPUT VOLTAGE†

#### **TYPICAL CHARACTERISTICS**

# MAXIMUM POSITIVE PEAK OUTPUT VOLTAGET VS OUTPUT CURRENT $T_{A} = -55^{\circ}C$ $T_{A} = 25^{\circ}C$ $T_{A} = 125^{\circ}C$ $T_{A} = 125^{\circ}C$ $T_{A} = 125^{\circ}C$ $T_{A} = 125^{\circ}C$ $T_{A} = 125^{\circ}C$

Figure 17

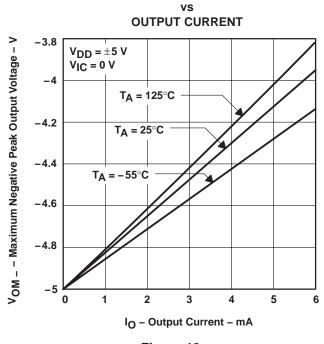
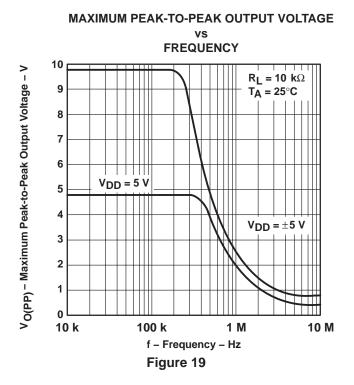
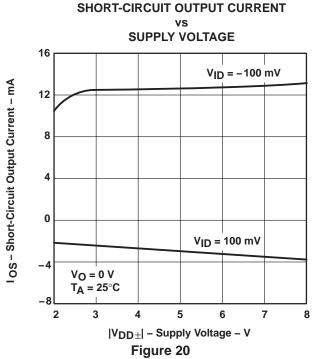


Figure 18





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



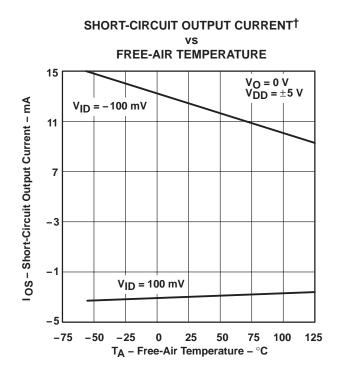


Figure 21

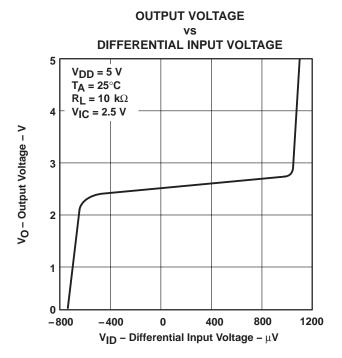


Figure 22

LARGE-SIGNAL DIFFERENTIAL

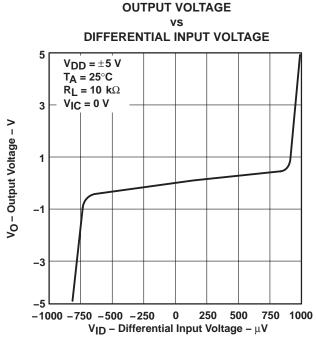


Figure 23

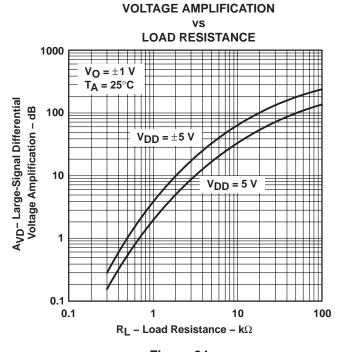


Figure 24

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



# LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN

**FREQUENCY** 80 180°  $V_{DD} = 5 V$  $R_L = 10 \text{ k}\Omega$   $C_L = 100 \text{ pF}$   $T_A = 25^{\circ}\text{C}$ 135° 60 A<sub>VD</sub>- Large-Signal Differential Voltage Amplification - dB 40 90° <sup>o</sup>m − Phase Margin 20 45° 0 **0**° -20 -45° -90° 1 k 10 k 100 k 1 M 10 M

Figure 25

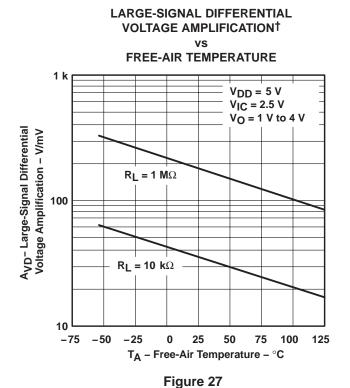
f - Frequency - Hz

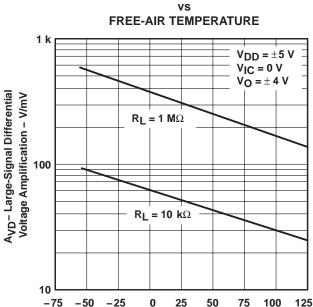
# LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN

**FREQUENCY** 80 180°  $V_{DD} = \pm 5 V$  $R_L = 10 \text{ k}\Omega$  $C_{L} = 100 \text{ pF}$ 135° 60  $T_A = 25^{\circ}C$ A<sub>VD</sub>- Large-Signal Differential Voltage Amplification - dB <sup>0</sup>m − Phase Margin 40 90° 45° 20 **0**° 0 -20 –45° -40 -90° 1 k 10 k 100 k 1 M 10 M f - Frequency - Hz

Figure 26







LARGE-SIGNAL DIFFERENTIAL

**VOLTAGE AMPLIFICATION**†

Figure 28

TA - Free-Air Temperature - °C

**OUTPUT IMPEDANCE** 

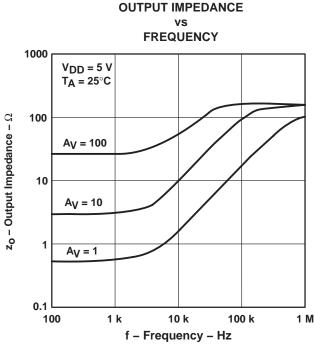
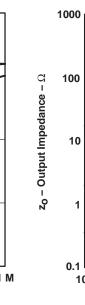
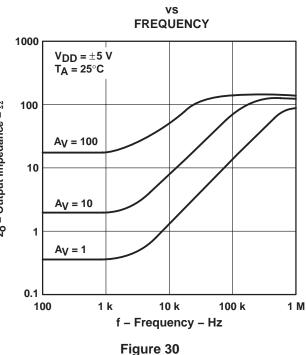


Figure 29



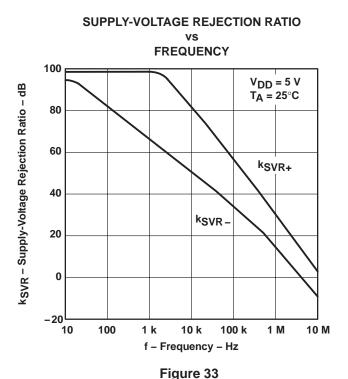


<sup>†</sup>Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



### **COMMON-MODE REJECTION RATIO FREQUENCY** 100 T<sub>A</sub> = 25°C CMRR - Common-Mode Rejection Ratio - dB $V_{DD} = \pm 5 V$ 80 $V_{DD} = 5 V$ 60 40 20 100 100 k 10 M 10 1 k 10 k 1 M f - Frequency - Hz

Figure 31



**COMMON-MODE REJECTION RATIO** 

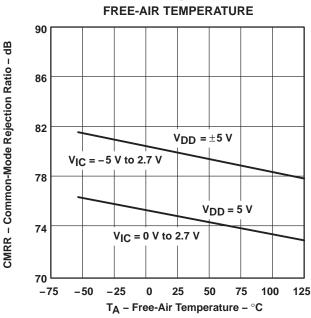


Figure 32

#### SUPPLY-VOLTAGE REJECTION RATIO

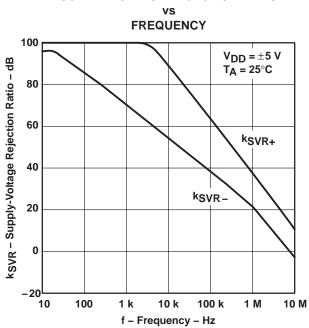
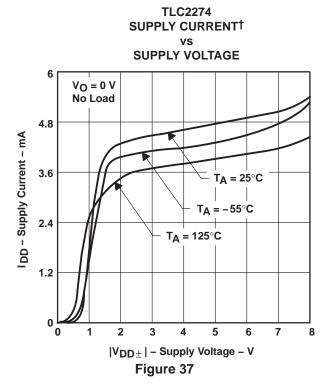


Figure 34

### SUPPLY VOLTAGE REJECTION RATIO† FREE-AIR TEMPERATURE $V_{DD} \pm = \pm 2.2 \text{ V to } \pm 8 \text{ V}$ kSVR - Supply Voltage Rejection Ratio - dB $V_O = 0 V$ 105 100 95 90 85 75 100 -50 25 -75 -25 50 $T_A$ – Free-Air Temperature – $^{\circ}C$

Figure 35



SUPPLY CURRENTT
VS
SUPPLY VOLTAGE

TA = 25°C

TA = -55°C

TA = 125°C

Figure 36

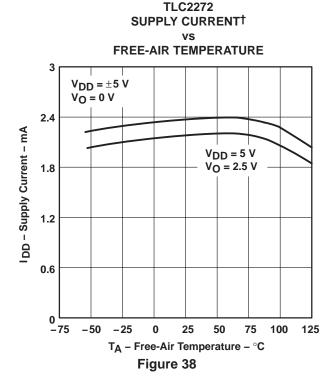
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|V<sub>DD±</sub> | - Supply Voltage - V

0

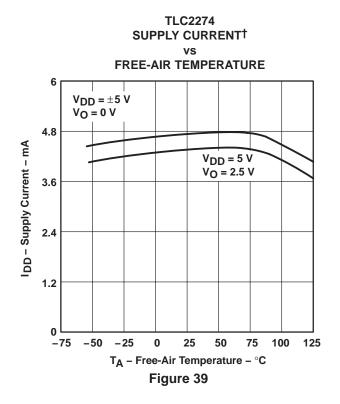
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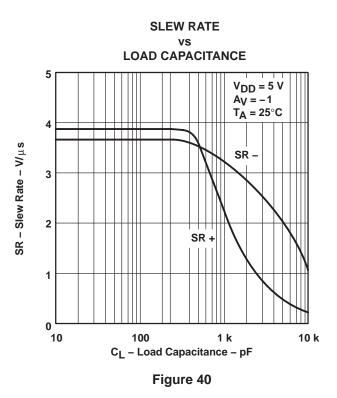
8



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

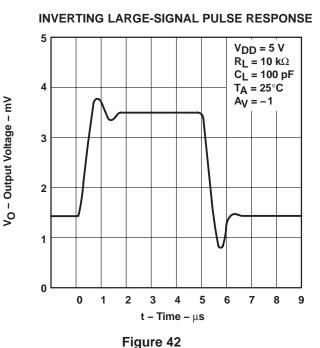






### **SLEW RATE**† FREE-AIR TEMPERATURE 5 SR -SR - Slew Rate - V/µs SR + 3 2 $V_{DD} = 5 V$ $R_L = 10 \text{ k}\Omega$ C<sub>L</sub> = 100 pF $A_V = 1$ 25 50 -75 -50 -25 0 75 100 125 T<sub>A</sub> - Free-Air Temperature - °C

Figure 41



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



#### **INVERTING LARGE-SIGNAL PULSE RESPONSE**

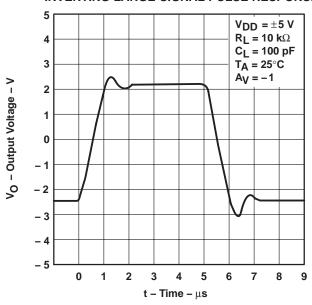


Figure 43

### VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

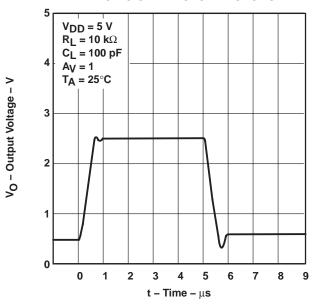


Figure 44

## VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

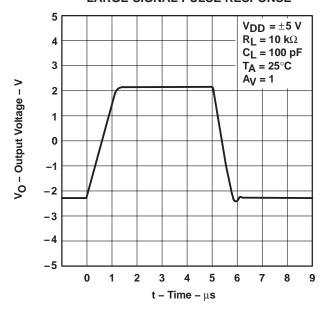


Figure 45

#### **INVERTING SMALL-SIGNAL PULSE RESPONSE**

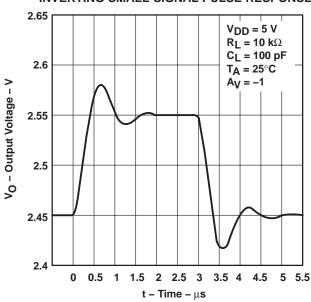


Figure 46



#### **INVERTING SMALL-SIGNAL PULSE RESPONSE** 100 $V_{DD} = \pm 5 V$ $R_L = 10 \text{ k}\Omega$ $C_{L} = 100 \text{ pF}$ $T_A = 25^{\circ}C$ A<sub>V</sub> = 1 50 Vo - Output Voltage - mV 0 -50 -1000 0.5 1.5 2 2.5 3 3.5 1

Figure 47

t – Time –  $\mu$ s

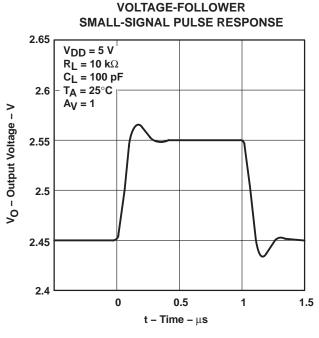
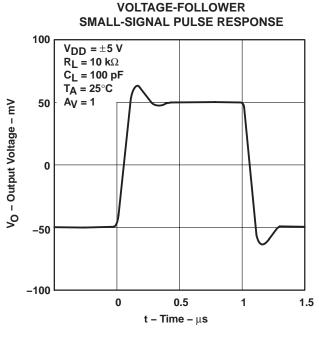
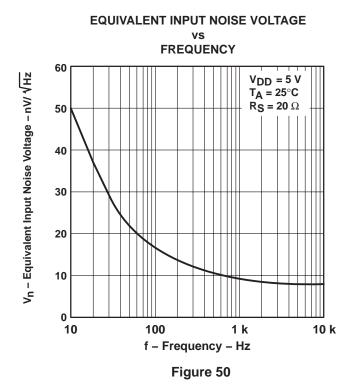


Figure 48







TEXAS INSTRUMENTS

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#### **EQUIVALENT INPUT NOISE VOLTAGE**

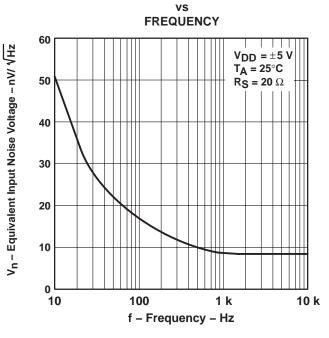


Figure 51

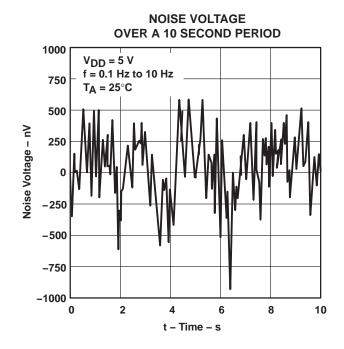


Figure 52

#### **INTEGRATED NOISE VOLTAGE**

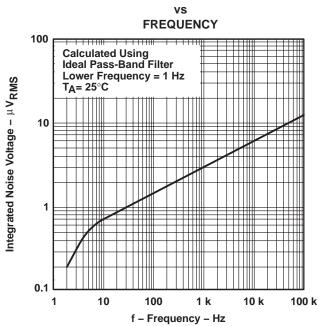


Figure 53

#### TOTAL HARMONIC DISTORTION PLUS NOISE

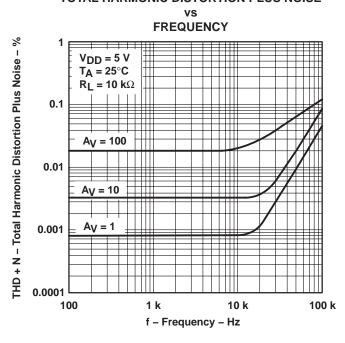
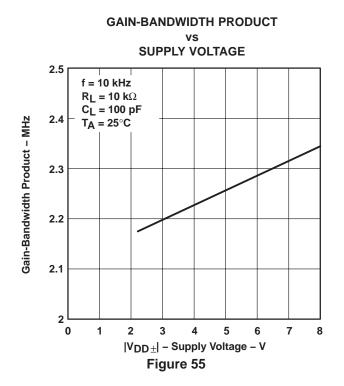
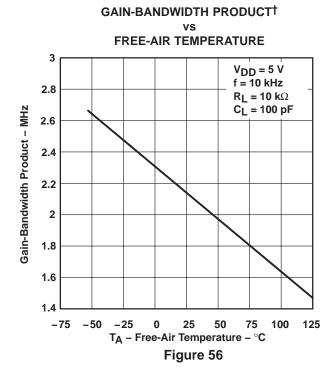
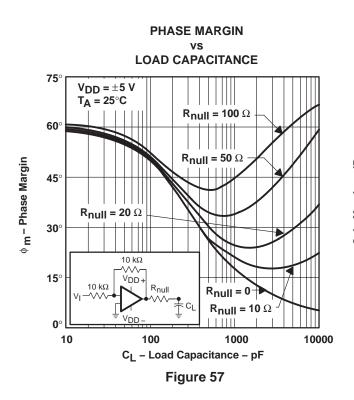


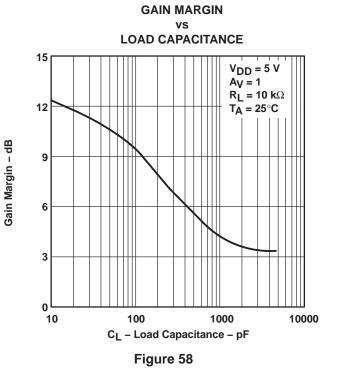
Figure 54











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



#### APPLICATION INFORMATION

#### macromodel information

Macromodel information provided was derived using Microsim  $Parts^{TM}$ , the model generation software used with Microsim  $PSpice^{TM}$ . The Boyle macromodel (see Note 5) and subcircuit in Figure 59 were generated using the TLC227x typical electrical and operating characteristics at  $T_A = 25^{\circ}C$ . 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 Integrated Circuit Operational Amplifiers", *IEEE Journal of Solid-State Circuits*, SC-9, 353 (1974).

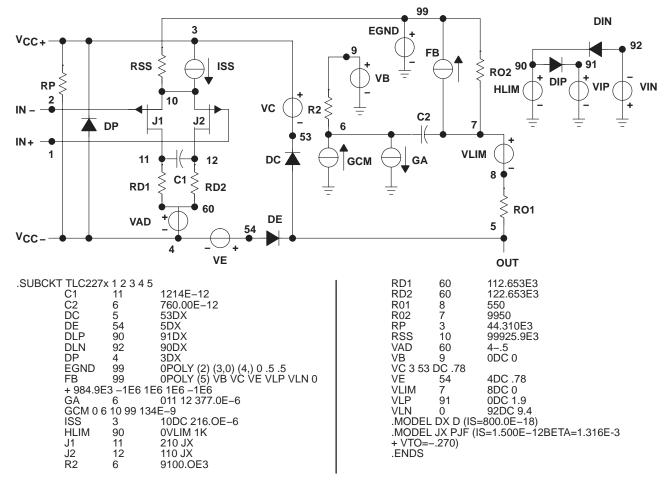
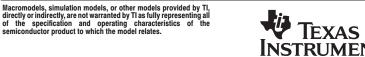


Figure 59. Boyle Macromodel and Subcircuit

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### **PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	n MSL Peak Temp <sup>(3)</sup>
5962-9318201M2A	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
5962-9318201MCA	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
5962-9318201QDA	ACTIVE	CFP	W	14	1	None	A42 SNPB	Level-NC-NC-NC
5962-9318202Q2A	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
5962-9318202QCA	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
5962-9318202QDA	ACTIVE	CFP	W	14	1	None	A42 SNPB	Level-NC-NC-NC
5962-9555201NXDR	ACTIVE	SOIC	D	8	2500	None	CU NIPDAU	Level-1-220C-UNLIM
5962-9555201Q2A	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
5962-9555201QHA	ACTIVE	CFP	U	10	1	None	A42 SNPB	Level-NC-NC-NC
5962-9555201QPA	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
5962-9555202Q2A	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
5962-9555202QHA	ACTIVE	CFP	U	10	1	None	A42 SNPB	Level-NC-NC-NC
5962-9555202QPA	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
TLC2272ACD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272ACDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272ACP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TLC2272ACPW	ACTIVE	TSSOP	PW	8	150	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272ACPWLE	OBSOLETE	TSSOP	PW	8		None	Call TI	Call TI
TLC2272ACPWR	ACTIVE	TSSOP	PW	8	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272AID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272AIDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272AIP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TLC2272AMD	ACTIVE	SOIC	D	8	75	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272AMDR	ACTIVE	SOIC	D	8	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272AMFKB	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TLC2272AMJGB	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
TLC2272AMP	OBSOLETE	PDIP	Р	8		None	Call TI	Call TI
TLC2272AMUB	ACTIVE	CFP	U	10	1	None	A42 SNPB	Level-NC-NC-NC
TLC2272AQD	ACTIVE	SOIC	D	8	75	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272AQDR	ACTIVE	SOIC	D	8	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272CD	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272CDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272CP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TLC2272CPSR	ACTIVE	SO	PS	8	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272CPW	ACTIVE	TSSOP	PW	8	150	None	CU NIPDAU	Level-1-220C-UNLIM





28-Feb-2005

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	n MSL Peak Temp <sup>(3)</sup>
TLC2272CPWLE	OBSOLETE	TSSOP	PW	8		None	Call TI	Call TI
TLC2272CPWR	ACTIVE	TSSOP	PW	8	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272ID	ACTIVE	SOIC	D	8	75	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272IDR	ACTIVE	SOIC	D	8	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2272IP	ACTIVE	PDIP	Р	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TLC2272IPW	ACTIVE	TSSOP	PW	8	150	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272IPWLE	OBSOLETE	TSSOP	PW	8		None	Call TI	Call TI
TLC2272IPWR	ACTIVE	TSSOP	PW	8	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272MD	ACTIVE	SOIC	D	8	75	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272MDR	ACTIVE	SOIC	D	8	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272MFKB	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TLC2272MJG	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
TLC2272MJGB	ACTIVE	CDIP	JG	8	1	None	A42 SNPB	Level-NC-NC-NC
TLC2272MP	OBSOLETE	PDIP	Р	8		None	Call TI	Call TI
TLC2272MUB	ACTIVE	CFP	U	10	1	None	A42 SNPB	Level-NC-NC-NC
TLC2272QD	ACTIVE	SOIC	D	8	75	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272QDR	ACTIVE	SOIC	D	8	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2272QPWR	ACTIVE	TSSOP	PW	8	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274ACD	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274ACDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR Level-1-220C-UNLIM
TLC2274ACN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPD	Level-NC-NC-NC
TLC2274ACPW	ACTIVE	TSSOP	PW	14	90	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274ACPWR	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AID	ACTIVE	SOIC	D	14	50	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AIDR	ACTIVE	SOIC	D	14	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AIN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPD	Level-NC-NC-NC
TLC2274AIPW	ACTIVE	TSSOP	PW	14	90	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AIPWLE	OBSOLETE	TSSOP	PW	14		None	Call TI	Call TI
TLC2274AIPWR	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AIPWRG4	PREVIEW	TSSOP	PW	14	2000	None	Call TI	Call TI
TLC2274AMD	ACTIVE	SOIC	D	14	50	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AMDR	ACTIVE	SOIC	D	14	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AMFKB	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TLC2274AMJB	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
TLC2274AMWB	ACTIVE	CFP	W	14	1	None	A42 SNPB	Level-NC-NC-NC
TLC2274AQD	ACTIVE	SOIC	D	14	50	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274AQDR	ACTIVE	SOIC	D	14	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274CD	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR Level-1-220C-UNLIM





.com 28-Feb-2005

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>
TLC2274CDB	ACTIVE	SSOP	DB	14	80	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274CDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274CN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPD	Level-NC-NC-NC
TLC2274CNS-A	ACTIVE	SO	NS	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274CNSR	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274CNSR-A	ACTIVE	SO	NS	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274CPW	ACTIVE	TSSOP	PW	14	90	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274CPWLE	OBSOLETE	TSSOP	PW	14		None	Call TI	Call TI
TLC2274CPWR	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274CPWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLC2274ID	ACTIVE	SOIC	D	14	50	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274IDR	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1YEAR/ Level-1-220C-UNLIM
TLC2274IN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPD	Level-NC-NC-NC
TLC2274IPW	ACTIVE	TSSOP	PW	14	90	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274IPWLE	OBSOLETE	TSSOP	PW	14		None	Call TI	Call TI
TLC2274IPWR	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274MD	ACTIVE	SOIC	D	14	50	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274MDR	ACTIVE	SOIC	D	14	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274MFKB	ACTIVE	LCCC	FK	20	1	None	POST-PLATE	Level-NC-NC-NC
TLC2274MJ	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
TLC2274MJB	ACTIVE	CDIP	J	14	1	None	A42 SNPB	Level-NC-NC-NC
TLC2274MN	ACTIVE	PDIP	N	14	25	None	Call TI	Level-NC-NC-NC
TLC2274MWB	ACTIVE	CFP	W	14	1	None	A42 SNPB	Level-NC-NC-NC
TLC2274QD	ACTIVE	SOIC	D	14	50	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274QDR	ACTIVE	SOIC	D	14	2500	None	CU NIPDAU	Level-1-220C-UNLIM
TLC2274Y	PREVIEW	XCEPT	Υ	0		None	Call TI	Call TI

<sup>&</sup>lt;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.

None: Not yet available Lead (Pb-Free).

**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.

<sup>(2)</sup> Eco Plan - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.



#### PACKAGE OPTION ADDENDUM

28-Feb-2005

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

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

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