捷多邦,专业PCB打样工厂,24**TbQ227x**5TLC227xA Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

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- 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/μs Typ

description

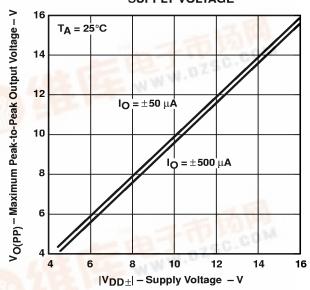
The TLC2272 and TLC2274 are dual and quadruple operational amplifiers from Texas Instruments. Both devices exhibit rail-to-rail output performance for increased dynamic range in single- or split-supply applications. The TLC227x family offers 2 MHz of bandwidth and 3 V/μs of slew rate for higher speed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

The TLC227x, exhibiting high input impedance and low noise, is excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the 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 family a great choice when interfacing with

 Low Input Offset Voltage 950 μV Max at T_A = 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 vs SUPPLY VOLTAGE



analog-to-digital converters (ADCs). For precision applications, the TLC227xA family is available and has a maximum input offset voltage of 950 μ V. 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, please see the TLV2211/21/31 family. These devices are single rail-to-rail operational amplifiers in the SOT-23 package. Their small size and low power consumption, make them ideal for high density, battery-powered equipment.



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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TLC2272 AVAILABLE OPTIONS

			PACKAGED DEVICE	s
TA	V _{IO} max At 25°C	SMALL OUTLINE† (D)	PLASTIC DIP (P)	TSSOP‡ (PW)
0°C to 70°C	950 μV 2.5 mV	TLC2272ACD TLC2272CD	TLC2272ACP TLC2272CP	TLC2272CPW
-40°C to 85°C	950 μV 2.5 mV	TLC2272AID TLC2272ID	TLC2272AIP TLC2272IP	_
-40°C to 125°C	950 μV 2.5 mV	TLC2272AQD TLC2272QD	_	TLC2272AQPW TLC2272QPW
-55°C to 125°C	950 μV 2.5 mV	TLC2272AMD TLC2272MD	TLC2272AMP TLC2272MP	_

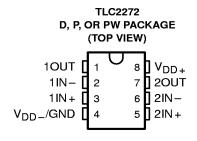
[†] The D packages are available taped and reeled. Add R suffix to the device type (e.g., TLC2272CDR).

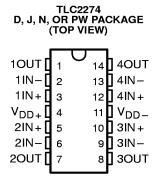
TLC2274 AVAILABLE OPTIONS

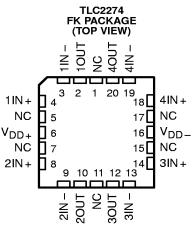
			PACKAGED DEVICES									
TA	25°C OUTLINET CARRIER DIP (D) (FK) (J)		CERAMIC DIP (J)	PLASTIC DIP (N)	TSSOP‡ (PW)							
0°C to 70°C	950 μV 2.5 mV	TLC2274ACD TLC2274CD	-	_	TLC2274ACN TLC2274CN	 TLC2274CPW						
−40°C to 85°C	950 μV 2.5 mV	TLC2274AID TLC2274ID	_	_	TLC2274AIN TLC2274IN	— TLC2274IPW						
−40°C to 125°C	950 μV 2.5 mV	TLC2274AQD TLC2274QD	_	_	_	_						
−55°C to 125°C	950 μV 2.5 mV	TLC2274AMD TLC2274MD	TLC2274AMFK TLC2274MFK	TLC2274AMJ TLC2274MJ	TLC2274AMN TLC2274MN	_						

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

[§] Chips are tested at 25°C.





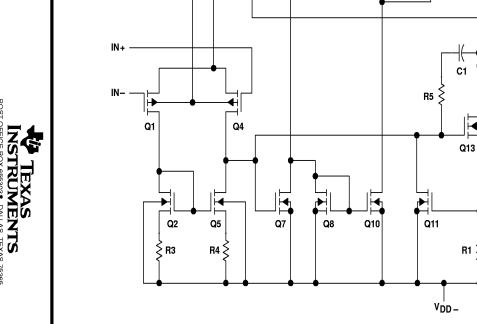


NC - No internal connection

[‡]The PW package is available taped and reeled. Add R suffix to the device type (e.g., TLC2272PWR).

^{\$} Chips are tested at 25°C.

[‡]The PW package is available taped and reeled.



Q3

Q6

equivalent schematic (each amplifier)

Q7		Q8	Q10	•	Q11	R1 S	>	 R2	D1 -	•
			•		۷۵	D –				
	ACT	UAL DEV	ICE CON	/IPONENT	COUN	IT†				
CC	OMPO	NENT	TLC	2272	TL	.C2274				
Trans	istors			38		76				
Resis	tors			26		52				
Diode	s			9		18				
Capa	citors			3		6				

 v_{DD+}

Q12

Q14

Q15

Q16

Q17

OUT

Q9

 $[\]ensuremath{^{\dagger}}$ Includes both amplifiers and all ESD, bias, and trim circuitry

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

Supply voltage, V _{DD+} (see Note 1)		
Supply voltage, V _{DD} (see Note 1)		
Differential input voltage, V _{ID} (see Note 2)		
Input voltage, V _I (any input, see Note 1)		
Input current, I _I (any input)		±5 mA
Output current, IO		
Total current into V _{DD+}		±50 mA
Total current out of V _{DD}		±50 mA
Duration of short-circuit current at (or below	w) 25°C (see Note 3)	unlimited
Continuous total dissipation		. See Dissipation Rating Table
Operating free-air temperature range, T _A :	C suffix	0°C to 70°C
	I suffix	–40°C to 85°C
	Q suffix	–40°C to 125°C
	M suffix	–55°C to 125°C
Storage temperature range		–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from	n case for 10 seconds: D, N, P or P\	W package 260°C
Lead temperature 1,6 mm (1/16 inch) from	n case for 60 seconds: J package	300°C

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between VDD+ and VDD-.
 - 2. Differential voltages are at IN+ with respect to IN-. Excessive current will flow if input is brought below VDD_- 0.3 V.
 - 3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_{\mbox{\scriptsize A}} \le 25^{\circ}\mbox{\scriptsize C}$ POWER RATING	DERATING FACTOR ABOVE T _A = 25°C	T _A = 70°C POWER RATING	T _A = 85°C POWER RATING	T _A = 125°C POWER RATING
D-8	725 mW	5.8 mW/°C	464 mW	337 mW	145 mW
D-14	950 mW	7.6 mW/°C	608 mW	494 mW	190 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
J	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW	230 mW
Р	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW
PW-8	525 mW	4.2 mW/°C	336 mW	273 mW	105 mW
PW-14	700 m W	5.6 mW/°C	448 m W	364 m W	_

recommended operating conditions

	С	SUFFIX	18	SUFFIX	Q	SUFFIX	М	SUFFIX	UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	UNIT
Supply voltage, V _{DD±}	±2.2	±8	±2.2	±8	±2.2	±8	±2.2	±8	٧
Input voltage range, V _I	V_{DD-}	V _{DD+} –1.5	V_{DD-}	V _{DD+} –1.5	V_{DD-}	V _{DD+} –1.5	V_{DD-}	V _{DD+} –1.5	V
Common-mode input voltage, V _{IC}	V_{DD-}	V _{DD+} -1.5	V_{DD-}	V _{DD+} -1.5	V _{DD} _	V _{DD+} –1.5	V_{DD-}	V _{DD+} –1.5	٧
Operating free-air temperature, TA	0	70	-40	85	-40	125	-55	125	°C



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

	DADAMETED	TEST CO	TEST CONDITIONS TAT TLC2272C TLC2272AC		C						
	PARAMETER	l lesi co	NDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
M	lancet offerst voltages			25°C		300	2500		300	950	/
V _{IO}	Input offset voltage			Full range			3000			1500	μV
αVIO	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 _O = 0,	$V_{DD} \pm = \pm 2.5 \text{ V},$ $R_S = 50 \Omega$	25°C		0.002			0.002		μV/mo
lı o	Input offset current	1		25°C		0.5			0.5		pА
lo	input onset current			Full range			100			100	PΑ
lв	Input bias current			25°C		1			1		pА
אוי	Input bias current			Full range			100			100	PA
VICR	Common-mode input	$R_S = 50 \Omega$,	V _O ≤5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
VICH	voltage range		V O 33111V	Full range	0 to 3.5			0 to 3.5			v
		I _{OH} = -20 μA		25°C		4.99			4.99		
	High level output	I _{OH} = -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
		I _{OH} = -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		
	Low-level output	V _{IC} = 2.5 V,	I _{OL} = 500 μA	25°C		0.09	0.15		0.09	0.15	
v_{OL}	voltage	V ₁ C = 2.5 V,	- 10[= 300 μΑ	Full range			0.15			0.15	V
	· ·	V _{IC} = 2.5 V,	I _{OL} = 5 mA	25°C		0.9	1.5		0.9	1.5	
		V ₁ C = 2.5 V,		Full range			1.5			1.5	
	Large-signal differential	V _{IC} = 2.5 V,	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	15	35		15	35		
A_{VD}	voltage amplification	$V_0 = 1 \text{ V to 4 V}$	_	Full range	15			15			V/mV
			$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
^r id	Differential input resistance			25°C		1012			10 ¹²		Ω
rį	Common-mode input resistance			25°C		1012			10 ¹²		Ω
cį	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		140			140		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = 0 \text{ to } 2.7 \text{ V},$ $V_{O} = 2.5 \text{ V},$	R _S = 50 Ω	25°C Full range	70 70	75		70 70	75		dB
	Supply-voltage rejection	V _{DD} = 4.4 V to	16 V,	25°C	80	95		80	95		,_
ksvr	ratio (ΔV _{DD} /ΔV _{IO})		No load	Full range	80			80			dB
	2 1 .	v 0-v	N. I. I	25°C		2.2	3		2.2	3	_
IDD	Supply current	$V_{O} = 2.5 \text{ V},$	No load	Full range			3			3	mA

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.



[‡]Referenced to 2.5 V

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

	PARAMETER	TEST CONDITI	ONE	T _A †	T	LC2272C	;	TI	LC2272A	С	UNIT
	PARAIVIE I ER	TEST CONDITION	ONS	'A'	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Slew rate at unity	V _O = 0.5 V to 2.5 V,		25°C	2.3	3.6		2.3	3.6		
SR	gain	$R_L = 10 \text{ k}\Omega^{\ddagger}, C_L =$	= 100 pFŦ	Full range	1.7			1.7			V/μs
	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ Hz
Vn	noise voltage	f = 1 kHz		25°C		9			9		nv/∀HZ
V _{NPP}	Peak-to-peak equivalent input	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
VNPP	noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μν
l _n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	-	$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	A _V = 1			0.0013%			0.0013%		
THD + N	Total harmonic distortion plus noise	f = 20 kHz,	A _V = 10	25°C		0.004%			0.004%		
	distortion plas holes	$R_L = 10 \text{ k}\Omega^{\ddagger}$,	A _V = 100			0.03%			0.03%		
	Gain-bandwidth product	f = 10 kHz, R _L : C _L = 100 pF [‡]	= 10 kΩ [‡] ,	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
t _s	Settling time	A _V = -1, Step = 0.5 V to 2.5 V,	То 0.1%	25°C		1.5			1.5		μs
'S	Cotting time	$R_L = 10 \text{ k}\Omega^{\ddagger}$, $C_L = 100 \text{ pF}^{\ddagger}$	То 0.01%	200		2.6			2.6		μο
φm	Phase margin at unity gain	R _L = 10 kΩ [‡] , C _L =	= 100 pF‡	25°C		50°			50°		
	Gain margin			25°C		10			10		dB

[†] Full range is 0°C to 70°C. ‡ Referenced to 2.5 V



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

	DADAMETED	TEST CO	MOITIONS	- +	TLC2272C TLC2272AC						
	PARAMETER	l lesi co	NDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	lanut effect veltage			25°C		300	2500		300	950	
V _{IO}	Input offset voltage			Full range			3000			1500	μV
^α VIO	Temperature coefficient of input offset voltage]		25°C to 70°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0,$ R _S = 50 Ω	$V_O = 0$,	25°C		0.002			0.002		μV/mo
lio	Input offset current			25°C		0.5			0.5		pА
		1		Full range			100			100	ı '
lв	Input bias current			25°C		1			1		pΑ
	·			Full range			100			100	
VICR	Common-mode input	$R_S = 50 \Omega$,	V _O ≤5 mV	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2		V
TICH	voltage range	113 = 55 32,	14101 =31114	Full range	-5 to 3.5			-5 to 3.5			ľ
		$I_{O} = -20 \mu\text{A}$		25°C		4.99			4.99		
		l∩ = −200 μA		25°C	4.85	4.93		4.85	4.93		
V _{OM+}	Maximum positive peak output voltage	$10 = -200 \mu A$	1	Full range	4.85			4.85			V
	output voltage	la 1 m A		25°C	4.25	4.65		4.25	4.65		
		$I_O = -1 \text{ mA}$		Full range	4.25			4.25			
		$V_{IC} = 0$,	$I_0 = 50 \mu A$	25°C		-4.99			-4.99		
	Maximum pagative pook	V _{IC} = 0,	l _O = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
V_{OM-}	Maximum negative peak output voltage	VIC = 0,	10 = 300 μΑ	Full range	-4.85			-4.85			V
	output voltage	V _{IC} = 0,	I _O = 5 mA	25°C	-3.5	-4.1		-3.5	-4.1		
		VIC = 0,	10 = 3 HIA	Full range	-3.5			-3.5			
	Large-signal differential		R _L = 10 kΩ	25°C	25	50		25	50		
A_{VD}	voltage amplification	$V_O = \pm 4 \text{ V}$	11[= 101/32	Full range	25			25			V/mV
			$R_L = 1 \text{ m}\Omega$	25°C		300			300		
^r id	Differential input resistance			25°C		1012			1012		Ω
rį	Common-mode input resistance			25°C		10 ¹²			1012		Ω
cį	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		130			130		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5 \text{ to } 2$ $V_{O} = 0 \text{ V},$	$R_{S} = 50 Ω$	25°C Full range	75 75	80		75 75	80		dB
	Supply-voltage rejection	V _{DD±} = 2.2	V to ±8 V.	25°C	80	95		80	95		
ksvr	ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	V _{IC} = 0,	No load	Full range	80			80			dB
	<u> </u>			25°C		2.4	3		2.4	3	
IDD	Supply current	V _O = 0 V N	No load	Full range			3			3	mA

† 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.



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

	ADAMETED	TEST CONDITIONS		- +	-	TLC2272C	;	Т	С	UNIT	
"	ARAMETER	I EST CONDITIO	JNS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Slew rate at	V- 122V B	. 10 kg	25°C	2.3	3.6		2.3	3.6		
SR	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		N// / / / /
Vn	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz
VNDD	Peak-to-peak equivalent input	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
V _{NPP}	noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μν
l _n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	$V_{O} = \pm 2.3 \text{ V},$	A _V = 1			0.0011%			0.0011%		
THD + N	distortion pulse	f = 20 kHz,	A _V = 10	25°C		0.004%			0.004%		
	duration	$R_L = 10 \text{ k}\Omega$	$A_{V} = 100$			0.03%			0.03%		
	Gain-bandwidth product	f = 10 kHz, R C _L = 100 pF	kL = 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
	Settling time	$A_V = -1$, Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		6
t _s	Settling time	R_L = 10 kΩ, C_L = 100 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

[†] Full range is 0°C to 70°C.



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

	DADAMETED	TEST CON	IDITIONS	_ +	Т	LC2274	С	TL	.C2274 <i>A</i>	C	
	PARAMETER	TEST CON	ADITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	land affect wells as			25°C		300	2500		300	950	\/
V _{IO}	Input offset voltage			Full range			3000			1500	μV
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)	$V_{DD\pm} = \pm 2.5 \text{ V},$ $V_{O} = 0,$	$V_{IC} = 0$, R _S = 50 Ω	25°C		0.002			0.002		μV/mo
lo	Input offset current			25°C		0.5			0.5		pА
טוי	input onset current			Full range			100			100	ΡΛ.
lв	Input bias current			25°C		1			1		pА
פוי	Impar blas carrent			Full range			100			100	Ρ/.
V _{ICR}	Common-mode input	$R_S = 50\Omega$,	$ V_{ O} \le 5 \text{ m V},$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
1011	voltage range		101	Full range	0 to 3.5			0 to 3.5			
		I _{OH} = -20 μA		25°C		4.99			4.99		
				25°C	4.85	4.93		4.85	4.93		
VOH	High-level output	I _{OH} = -200 μA		Full range	4.85			4.85			V
	voltage			25°C	4.25	4.65		4.25	4.65		
		I _{OH} = -1 mA		Full range	4.25			4.25			
		V _{IC} = 2.5 V,	I _{OL} = 50 μA	25°C		0.01			0.01		
		V _{IC} = 2.5 V,		25°C		0.09	0.15		0.09	0.15	
v_{OL}	Low-level output voltage	I _{OL} = 500 μA		Full range			0.15			0.15	٧
	vonago	V:0 25V	I _{OL} = 5 mA	25°C		0.9	1.5		0.9	1.5	
		$V_{IC} = 2.5 V,$	IOC = 2 IIIA	Full range			1.5			1.5	
	Large-signal differential	V _{IC} = 2.5 V,	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	15	35		15	35		
AVD	voltage amplification	$V_0 = 2.5 \text{ V},$ $V_0 = 1 \text{ V to 4 V}$	TIL = TO KS21	Full range	15			15			V/mV
	7 9p	.0	$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
^r id	Differential input resistance			25°C		1012			1012		Ω
rį	Common-mode input resistance			25°C		1012			10 ¹²		Ω
c _i	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		140			140		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = 0 \text{ to } 2.7 \text{ V},$ $V_{O} = 2.5 \text{ V},$	$R_S = 50\Omega$	25°C Full range	70 70	75		70 70	75		dB
1.	Supply-voltage rejection	V _{DD} = 4.4 V to 1	6 V,	25°C	80	95		80	95		15
ksvr	ratio (ΔV _{DD} /ΔV _{IO})	$V_{IC} = V_{DD}/2$,	No load	Full range	80			80			dB
	Committee accomment	V 05V	NI= I==='	25°C		4.4	6		4.4	6	^
IDD	Supply current	$V_O = 2.5 V$,	No load	Full range			6			6	mA

[†] 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.



[‡]Referenced to 2.5 V

TLC227x, TLC227xA Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS SLOS190B – FEBRUARY 1997 – REVISED JULY 1999

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

	RAMETER	TEST CONDITIONS		- +	٦	ΓLC2274C	;	TL	C2274A	С	UNIT
PA	KAMETEK	TEST CONDI	HONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNII
	Slew rate at	V 05VL 05V		25°C	2.3	3.6		2.3	3.6		
SR	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
V	Equivalent input	f = 10 Hz		25°C		50			50		VI /II
V _n	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz
Vivon)	Peak-to-peak equivalent input	f = 0.1 to 1 Hz		25°C		1			1		μV
V _{N(PP)}	noise voltage	f = 0.1 to 10 Hz		25°C		1.4			1.4		μ ν
l _n	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 _V = 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 kHz, C _L = 100 pF‡	$R_L = 10 \text{ k}\Omega^{\ddagger}$,	25°C		2.18			2.18		MHz
ВОМ	Maximum output-swing bandwidth	V _O (PP) = 2 V, R _L = 10 kΩ [‡] ,	A _V = 1, C _L = 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		II e
t _s	Setting time	$R_L = 10 \text{ k}\Omega^{\ddagger}$, $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	23 0		2.6			2.6		μs
φm	Phase margin at unity gain	R _L = 10 kΩ [‡] ,	C _L = 100 pF‡	25°C		50°			50°		
	Gain margin] -		25°C		10			10		dB

[†] Full range is 0°C to 70°C. ‡ Referenced to 2.5 V

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

αVIO	PARAMETER Input offset voltage	1231 00	ONDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
αVIO	<u> </u>			0500							
αVIO ,	<u> </u>			25°C		300	2500		300	950	μV
αVIO				Full range			3000			1500	μν
	Temperature coefficient of input offset voltage			25°C to 70°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$, R _S = 50 Ω	$V_O = 0$,	25°C		0.002			0.002		μV/mo
1	I			25°C		0.5			0.5		A
lo	Input offset current			Full range			100			100	pΑ
				25°C		1			1		
lВ	Input bias current			Full range			100			100	pΑ
	Common-mode input voltage range	R _S = 50 Ω,	$ V_{O} \le 5 \text{ mV}$	25°C	-5 to 4 -5	-5.3 to 4.2		-5 to 4 -5	-5.3 to 4.2		V
	g-			Full range	to 3.5			to 3.5			
		$I_{O} = -20 \mu A$	ı	25°C		4.99			4.99		
	Maximum positive peak output	I _O = -200 μ	Δ	25°C	4.85	4.93		4.85	4.93		
V _{OM+}	voltage	10 = -200 μ	^	Full range	4.85			4.85			\ \
	3	I _O = -1 mA		25°C	4.25	4.65		4.25	4.65		
		10 = - 1 IIIA		Full range	4.25			4.25			
		V _{IC} = 0,	I _O = 50 μA	25°C		-4.9 9			-4.9 9		
	Maximum negative peak output	V:- 0	ΙΟ = 500 μΑ	25°C	-4.8 5	-4.9 1		-4.8 5	-4.9 1		.,
V _{OM} -	voltage	V _{IC} = 0,	ΙΟ = 300 μΑ	Full range	-4.8 5			-4.8 5			V
		V:0 - 0	lo 5 m A	25°C	-3.5	-4.1		-3.5	-4.1		
		$V_{IC} = 0$,	$I_O = -5 \text{ mA}$	Full range	-3.5			-3.5			
			D 1010	25°C	25	50		25	50		
	Large-signal differential voltage amplification	V _O = ±4 V	$R_L = 10 \text{ k}\Omega$	Full range	25			25			V/mV
·			$R_L = 1 M\Omega$	25°C		300			300		
^r id	Differential input resistance			25°C		1012			1012		Ω
	Common-mode input resistance			25°C		1012			1012		Ω
C.	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		130			130		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5 V f$ $V_{O} = 0$,	to 2.7 V, R _S = 50 Ω	25°C Full range	75 75	80		75 75	80		dB
	Supply-voltage rejection ratio	V _{DD±} = ±2.	2 V to +8 V	25°C	80	95		80	95		
V	$(\Delta V_{DD\pm}/\Delta V_{IO})$	$V_{IC} = 0,$	No load	Full range	80			80			dB
				25°C	L 	4.8	_		4.5	2 2	
		1		ソッツ:		21 X	6		4.8	6	1

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.



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

Б	ADAMETED	TEGT COMPLETE	NC.		7	ΓLC22740	;	TI	_C2274A	С	LINUT
P.	ARAMETER	TEST CONDITION	DINS	TAT	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Class rate at units	V- 100V D	1010	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
V	Equivalent input	f = 10 Hz		25°C		50			50		VII.
Vn	noise voltage	f = 1 Hz		25°C		9			9		nV/√Hz
Veren	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		\/
V _{N(PP)}	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μV
I _n	Equivalent input noise current			25°C		0.6			0.6		fA /√Hz
	Total harmonic $V_O = \pm 2.3 \text{ V}$, Av		A _V = 1			0.0011%			0.0011%		
THD + N	distortion plus	f = 20 kHz,	A _V = 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 _L = 100 pF	10 kΩ,	25°C		2.25			2.25		MHz
ВОМ	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
	Sattling time	$A_V = -1$, Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		
t _s	Settling 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 kΩ, C _L =	100 pF	25°C		52°			52°		
	Gain margin	1		25°C		10			10		dB

[†] Full range is 0°C to 70°C.

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

	DADAMETED	TEST COM	IDITIONS	T. +	Т	LC2272	!	TI	LC2272	ΔI	LINUT
	PARAMETER	TEST CON	NUTTIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	Innut offset voltage			25°C		300	2500		300	950	μV
V _{IO}	Input offset voltage			Full range			3000			1500	μν
αVIO	Temperature coefficient of input offset voltage],, ,		25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0,$ $V_{O} = 0,$	$V_{DD\pm}=\pm 2.5V$ $R_S = 50 \Omega$	25°C		0.002			0.002		μV/mo
l. =	Input offset current			25°C		0.5			0.5		pА
lo	input onset current			Full range			150			150	PΑ
lв	Input bias current			25°C		1			1		pА
אוי	Input bias current			Full range			150			150	PΛ
Vice	Common-mode input			25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		٧
VICR	voltage range	$R_S = 50 \Omega$,	V _{IO} ≤5 mV	Full range	0 to 3.5			0 to 3.5			V
		I _{OH} = -20 μA		25°C		4.99			4.99		
	I limb laval avdavd	I _{OH} = -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
	9-	I _{OH} = -1 mA		25°C	4.25	4.65		4.25	4.65		
				Full range	4.25			4.25			
		$V_{IC} = 2.5 \text{ V},$	$I_{OL} = 50 \mu\text{A}$	25°C		0.01			0.01		
	Low-level output	V _{IC} = 2.5 V,	I _{OL} = 500 μA	25°C		0.09	0.15		0.09	0.15	
V_{OL}	voltage			Full range			0.15			0.15	V
		V _{IC} = 2.5 V,	$I_{OL} = 5 \text{ mA}$	25°C		0.9	1.5		0.9	1.5	
		1.0		Full range	45		1.5	45		1.5	
	Large-signal differential	V _{IC} = 2.5 V,	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	15	35		15 15	35		N// N/
A_{VD}	voltage amplification	$V_0 = 1 \text{ V to 4 V}$	$R_L = 1 \text{ m}\Omega^{\ddagger}$	Full range 25°C	15	175		15	175		V/mV
^r id	Differential input resistance		K[= 1 m22+	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 _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		140			140		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = 0 \text{ to } 2.7 \text{ V},$ $V_{O} = 2.5 \text{ V},$	R _S = 50 Ω	25°C Full range	70 70	75		70 70	75		dB
k _{SVR}	Supply-voltage rejection ratio (ΔV _{DD} /ΔV _{IO})	$V_{DD} = 4.4 \text{ V to}$ $V_{IC} = V_{DD}/2$,	16 V, No load	25°C Full range	80 80	95		80 80	95		dB
la a	Supply ourrest	Va 25V	No load	25°C		2.2	3		2.2	3	A
IDD	Supply current	$V_{O} = 2.5 \text{ V},$	NO IOAU	Full range			3			3	mA

[†] Full range is – 40°C to 85°C.

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



[‡]Referenced to 2.5 V

TLC227x, TLC227xA Advanced LinCMOSTM RAIL-TO-RAIL OPERATIONAL AMPLIFIERS SLOS190B - FEBRUARY 1997 - REVISED JULY 1999

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

	ADAMETED	TEST CONDITIO	NC	- +		TLC2272I		٦	TLC2272AI		UNIT
P'	ARAMETER	TEST CONDITION	ONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Slew rate at	V- 05 V+- 25 V		25°C	2.3	3.6		2.3	3.6		
SR	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
V	Equivalent input	f = 10 Hz		25°C		50			50		nV√Hz
Vn	noise voltage	f = 1 kHz		25°C		9			9		nv∿Hz
V _{NPP}	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
ANPP	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μν
l _n	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 _V = 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	$f = 10 \text{ kHz}, R_l$ $C_L = 100 \text{ pF}^{\ddagger}$	_ = 10 kΩ [‡] ,	25°C		2.18			2.18		MHz
ВОМ	Maximum output- swing bandwidth		/ = 1, _ = 100 pF‡	25°C		1			1		MHz
	0 1111	A _V = -1, Step = 0.5 V to 2.5 V,	To 0.1%	25.0		1.5			1.5		
t _s	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
фm	Phase margin at unity gain	$R_L = 10 \text{ k}\Omega^{\ddagger}, \qquad C_L$	_ = 100 pF‡	25°C		50°			50°		
	Gain margin			25°C		10			10		dB

[†] Full range is – 40°C to 85°C.



[‡]Referenced to 2.5 V

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

	PARAMETER	TEST CON	DITIONS	T.+	Т	LC2272		T	LC2272A		118.77
	PARAMETER	TEST CON	DITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V _{IO}	Input offset voltage			25°C		300	2500		300	950	μV
ν ΙΟ	<u> </u>			Full range			3000			1500	μν
ανιο	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0,$ R _S = 50 Ω	V _O = 0,	25°C		0.002			0.002		μV/mo
lio	Input offset current			25°C		0.5			0.5		pА
0	Input onset current			Full range			150			150	PA
I _{IB}	Input bias current			25°C		1			1		pΑ
'ID	Impar blab carrent			Full range			150			150	
V	Common-mode input	D- 50.0	\/. = < 5 m \/	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2		v
VICR	voltage range	$R_S = 50 \Omega$,	V _{IO} ≤5 mV	Full range	−5 to 3.5			−5 to 3.5			V
		I _O = -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 μA		Full range	4.85			4.85			V
	output voltage			25°C	4.25	4.65		4.25	4.65		
		$I_O = -1 \text{ mA}$		Full range	4.25			4.25			
		V _{IC} = 0,	I _O = 50 μA	25°C		-4.99			-4.99		1
		V 0	l _O = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
VOM-	Maximum negative peak output voltage	V _{IC} = 0,	IQ = 500 μA	Full range	-4.85			-4.85			V
	peak output voltage	V ₁ 0	l _O = 5 mA	25°C	-3.5	-4.1		-3.5	-4.1		
		V _{IC} = 0,	IO = 2 IIIA	Full range	-3.5			-3.5			
	Large-signal		R _L = 10 kΩ	25°C	25	50		25	50		
AVD	differential voltage	V _O = ±4 V	H_ = 10 KS2	Full range	25			25			V/mV
	amplification		$R_L = 1 \text{ m}\Omega$	25°C		300			300		
^r id	Differential input resistance			25°C		1012			1012		Ω
ri	Common-mode input resistance			25°C		10 ¹²			1012		Ω
°i	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		130			130		Ω
CMRR	Common-mode	$V_{IC} = 0 \text{ to } 2.7 \text{ V},$		25°C	75	80		75	80		dB
	rejection ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	75			75			ub
KSVR	Supply-voltage rejection ratio	$V_{DD} = 4.4 \text{ V to}$	16 V, No load	25°C	80	95		80	95		dB
	(ΔV _{DD±} /ΔV _{IO})	$V_{IC} = V_{DD}/2$,	INO IOAU	Full range	80			80			
DD	Supply current	V _O = 2.5 V,	No load	25°C		2.4	3		2.4	3	mA
טט	PP-,	1 .0 = 2.0 1,		Full range			3			3	, \

[†] Full range is – 40°C to 85°C.

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



TLC227x, TLC227xA Advanced LinCMOSTM RAIL-TO-RAIL OPERATIONAL AMPLIFIERS SLOS190B - FEBRUARY 1997 - REVISED JULY 1999

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

	ADAMETED	TEST CONDITIO	NC.	- +		TLC2272I		Т	LC2272A	.I	UNIT
P'	ARAMETER	TEST CONDITION	DNS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Slew rate at	V _O = ±2.3 V, R	ı = 10 kΩ,	25°C	2.3	3.6		2.3	3.6		
SR	unity gain	C _L = 100 pF	L 1-1	Full range	1.7			1.7			V/μs
V	Equivalent input	f = 10 Hz		25°C		50			50		nV√Hz
V _n	noise voltage	f = 1 kHz		25°C		9			9		Π V V⊓Z
V _{NPP}	Peak-to-peak equivalent input	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
VNPP	noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μν
In	Equivalent input noise current			25°C		0.6			0.6		fA√Hz
	Total harmonic	V _O = ±2.3 V	A _V = 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 _L = 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
t _s	Settling time	$A_V = -1$, Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		μs
'S	Colling time	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	To 0.01%	25 5		3.2			3.2		μο
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

[†] Full range is -40°C to 85°C.

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

	PARAMETER	TEST CON	IDITIONS	T.+	Т	LC2274	H	TL	.C2274	Al	UNIT
	FARAMILIER	TEST CON	IDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNII
Via	Input offset voltage			25°C		300	2500		300	950	μV
V _{IO}	iliput oliset voltage			Full range			3000			1500	μν
ανιο	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{DD\pm} = \pm 2.5 \text{ V},$ $V_{O} = 0,$	$V_{IC} = 0$, R _S = 50 Ω	25°C		0.002			0.002		μV/mo
		1	_	25°C		0.5			0.5		
lo	Input offset current			Full range			150			150	pΑ
				25°C		1			1		,
lΒ	Input bias current			Full range			150			150	pΑ
V _{ICR}	Common-mode input	$R_S = 50 \Omega$,	V _O ≤ 5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		v
TICH	voltage range		14101= 5	Full range	0 to 3.5			0 to 3.5			•
		I _{OH} = -20 μA		25°C		4.99			4.99		
		I _{OH} = -200 μA		25°C	4.85	4.93		4.85	4.93		
V_{OH}	High-level output voltage	-011 =00 p		Full range	4.85			4.85			V
		I _{OH} = -1 mA		25°C	4.25	4.65		4.25	4.65		
				Full range	4.25			4.25			
		$V_{IC} = 2.5 \text{ V},$	I _{OL} = 50 μA	25°C		0.01			0.01		
		V _{IC} = 2.5 V,	I _{OL} = 500 μA	25°C		0.09	0.15		0.09	0.15	
V_{OL}	Low-level output voltage			Full range			0.15			0.15	V
		V _{IC} = 2.5 V,	$I_{OL} = 5 \text{ mA}$	25°C		0.9	1.5		0.9	1.5	
			· -	Full range			1.5			1.5	
_	Large-signal differential	V _{IC} = 2.5 V,	$R_L = 10 \text{ k}\Omega^{\ddagger}$	25°C	15	35		15	35		
A_{VD}	voltage amplification	V _O = 1 V to 4 V		Full range	15			15			V/mV
			$R_L = 1 M\Omega^{\ddagger}$	25°C		175			175		
^r 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,	N package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		140			140		Ω
CMDD	Common-mode rejection	$V_{IC} = 0 \text{ to } 2.7 \text{ V},$		25°C	70	75		70	75		-15
CMRR	ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	70			70			dB
1.	Supply-voltage rejection	V _{DD} = 4.4 V to 1	6 V,	25°C	80	95		80	95		.15
ksvr	ratio ($\Delta V_{DD} / \Delta V_{IO}$)	$V_{IC} = V_{DD}/2$	No load	Full range	80			80			dB
1	Commission of the Commission o	V- 05V	Nelsed	25°C		4.4	6		4.4	6	^
IDD	Supply current	$V_{O} = 2.5 V$,	No load	Full range			6			6	—l mA

[†] Full range is – 40°C to 85°C.

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



[‡]Referenced to 2.5 V

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

	PARAMETER	TEST CONDITION	ONE	_ +	-	TLC2274I		Т	LC2274A	I	UNIT
	PARAIVIETER	TEST CONDITION	ONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Slow rate at unity	V- 05 V to 2.5 V		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
Vn	Equivalent input	f = 10 Hz		25°C		50			50		nV/√ Hz
٧n	noise voltage	f = 1 kHz		25°C		9			9		nv/√Hz
Veren	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
V _{N(PP)}	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μ ν
In	Equivalent input noise current			25°C		0.6			0.6		fA /√Hz
	-	$V_0 = 0.5 \text{ V to } 2.5 \text{ V},$ $A_V = 1$				0.0013%			0.0013%		
THD + N	Total harmonic distortion plus noise	f = 20 kHz,	A _V = 10	25°C		0.004%			0.004%		
		$R_L = 10 \text{ k}\Omega^{\ddagger}$	$A_{V} = 100$			0.03%			0.03%		
	Gain-bandwidth product	f = 10 kHz, R _L = C _L = 100 pF‡	10 kΩ [‡] ,	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‡	25°C		1			1		MHz
t _s	Settling time	$A_V = -1$, Step = 0.5 V to 2.5 V,	To 0.1%	25°C		1.5			1.5		μs
'S	Setting time	$R_L = 10 \text{ k}\Omega^{\ddagger}$, $C_L = 100 \text{ pF}^{\ddagger}$	То 0.01%	25 0		2.6			2.6		μο
φm	Phase margin at unity gain	R _L = 10 kΩ [‡] , C _L =	100 pF‡	25°C		50°			50°		
	Gain margin			25°C		10			10		dB

[†] Full range is – 40°C to 85°C. ‡ Referenced to 2.5 V

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

	PARAMETER	TEST C	ONDITIONS	-+	Т	LC2274	I	Т	LC2274A	VI .	LINIT
	PARAMETER	123100	DINDITIONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
Via	Input offset voltage			25°C		300	2500		300	950	μV
V _{IO}	Input offset voltage			Full range			3000			1500	μν
ανιο	Temperature coefficient of input offset voltage			25°C to 85°C		2			2		μV/°C
	Input offset voltage Iong-term drift (see Note 4)	$V_{IC} = 0$, $R_S = 50 \Omega$	$V_O = 0$,	25°C		0.002			0.002		μV/mo
lıo	Input offset current			25°C		0.5			0.5		pА
ΙΟ	input onset current			Full range			150			150	PΛ
I _{IB}	Input bias current			25°C		1			1		pА
אוי	Input bias current			Full range			150			150	PΛ
	Common-mode input	D- F0.0	\\\\.\< F\\	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2		V
VICR	voltage range	HS = 50 Ω,	$ V_{O} \le 5 \text{ mV}$	Full range	-5 to 3.5			−5 to 3.5			V
		I _O = -20 μA		25°C		4.99			4.99		
			^	25°C	4.85	4.93		4.85	4.93		
V _{OM+}	Maximum positive peak output voltage	l _O = -200 μ	А	Full range	4.85			4.85			V
	ou.por. ronlago	I- 1 m A		25°C	4.25	4.65		4.25	4.65		
		$I_{O} = -1 \text{ mA}$		Full range	4.25			4.25			
		$V_{IC} = 0$,	I _O = 50 μA	25°C		-4.99			-4.99	99	
	Mandani and an addition and also	V _{IC} = 0,	l _O = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
V _{OM} -	Maximum negative peak output voltage	V ₁ C = 0,	10 = 300 μΑ	Full range	-4.85			-4.85			٧
	1	V _{IC} = 0,	$I_O = 5 \text{ mA}$	25°C	-3.5	-4.1		-3.5	-4.1		
		VIC = 0,	10 = 5 IIIA	Full range	-3.5			-3.5			
	Large-signal differential		R _L = 10 kΩ	25°C	25	50		25	50		
A_{VD}	voltage amplification	$V_0 = \pm 4 \text{ V}$	11 - 10 132	Full range	25			25			V/mV
			$R_L = 1 M\Omega$	25°C		300			300		
^r 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,	N package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		130			130		Ω
CMRR	Common-mode rejection	$V_{IC} = -5$ to		25°C	75	80		75	80		dB
OWITH	ratio	$V_{O} = 0$,	$R_S = 50 \Omega$	Full range	75			75			ub
kov ro	Supply-voltage rejection	V _{DD±} = ±2.		25°C	80	95		80	95		dB
ksvr	ratio (ΔV _{DD±} /ΔV _{IO})	V _{IC} = 0,	No load	Full range	80			80			ub
loo	Supply current	V _O = 0,	No load	25°C		4.8	6		4.8	6	mA
IDD	Cappiy Current	1 1 1 1 1 1 1 1 1 1	140 IOQU	Full range			6			6	'''^

[†] Full range is – 40°C to 85°C.

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



TLC227x, TLC227xA Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS SLOS190B – FEBRUARY 1997 – REVISED JULY 1999

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

	ADAMETED	TEST CONDITION	ONE	- +		TLC2274I		Т	LC2274A	Ţ	UNIT
"	ARAMETER	TEST CONDITION	ONS	T _A †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Class rate at smits	V- 100V B	. 1010	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 pF	L = 10 kΩ,	Full range	1.7			1.7			V/μs
V	Equivalent input	f = 10 Hz		25°C		50			50		N//III
V _n	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz
VALCED	Peak-to-peak eguivalent input	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
V _{N(PP)}	noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μν
In	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	V _O = ±2.3 V,	A _V = 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 _L = 100 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
	Settling time	A _V = -1, Step = -2.3 V to 2.3 V,	To 0.1%	25°C		1.5			1.5		= 6
t _s	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

[†]Full range is -40°C to 85°C.

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

	PARAMETER	TEST CO	NDITIONS	T _A †		.C2272 .C2272	′		C2272A C2272A		UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage			25°C		300	2500		300	950	μV
10	Importancer variage			Full range			3000			1500	μ,
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 _O = 0,	$V_{DD\pm} = \pm 2.5 \text{ V},$ R _S = 50 Ω	25°C		0.002			0.002		μV/mo
lio	Input offset current			25°C		0.5			0.5		pА
10	input onset current			Full range			500			500	p/\
lip	Input bias current			25°C		1			1		pА
lΒ	input bias current			Full range			500			500	PΑ
VICR	Common-mode input	Rs = 50 Ω,	V _{IO} ≤5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
1011	voltage range		1101 ==	Full range	0 to 3.5			0 to 3.5			
		I _{OH} = -20 μA		25°C		4.99			4.99		
	UB-da Laccal acidad d	Jan. 200 u A		25°C	4.85	4.93		4.85	4.93		
Vон	High-level output voltage	I _{OH} = -200 μA		Full range	4.85			4.85			V
	vonage	I 1 1		25°C	4.25	4.65		4.25	4.65		
		$I_{OH} = -1 \text{ mA}$		Full range	4.25			4.25			
		$V_{IC} = 2.5 V$,	I _{OL} = 50 μA	25°C		0.01			0.01		
		V _{IC} = 2.5 V,	l _{OL} = 500 μA	25°C		0.09	0.15		0.09	0.15	
v_{OL}	Low-level output voltage	V C = 2.5 V,	ΙΟΕ = 300 μΑ	Full range			0.15			0.15	V
		V _{IC} = 2.5 V,	I _{OL} = 5 mA	25°C		0.9	1.5		0.9	1.5	
		V ₁ C = 2.5 V,	IOL = 3 IIIA	Full range			1.5			1.5	
	Large-signal	V _{IC} = 2.5 V,	R _L = 10 kΩ [‡]	25°C	10	35		10	35		
A_{VD}	differential voltage	$V_0 = 1 \text{ V to 4 V}$		Full range	10			10			V/mV
	amplification		$R_L = 1 \text{ m}\Omega^{\ddagger}$	25°C		175			175		
^r id	Differential input resistance			25°C		1012			10 ¹²		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 _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		140			140		Ω
CMRR	Common-mode rejection ratio	$V_{ C} = 0 \text{ to } 2.7 \text{ V},$ $V_{O} = 2.5 \text{ V},$	$R_S = 50 \Omega$	25°C Full range	70 70	75		70 70	75		dB
1.	Supply-voltage rejection	$V_{DD} = 4.4 \text{ V to}^{-1}$	16 V,	25°C	80	95		80	95		-15
ksvr	ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{IC} = V_{DD}/2$	No load	Full range	80			80			dB
	O	V 05.V	NI- II	25°C		2.2	3		2.2	3	_ ^
IDD	Supply current	$V_{O} = 2.5 \text{ V},$	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.



[‡]Referenced to 2.5 V

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

P#	ARAMETER	TEST CONDITION	ons	T _A †		LC2272G	,		.C2272A0 .C2272AI		UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
	Slew rate at	V- 105 V+0 0.75 V		25°C	2.3	3.6		2.3	3.6		
SR	unity gain	$V_O = 1.25 \text{ V to } 2.75 \text{ V},$ $R_L = 10 \text{ k}\Omega^{\ddagger}, \qquad C_L = 10 \text{ k}\Omega^{\ddagger}$: 100 pF‡	Full range	1.7			1.7			V/µs
V	Equivalent input	f = 10 Hz		25°C		50			50		NA JUL
V _n	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz
V	Peak-to-peak	f = 0.1 Hz to 1 Hz f = 0.1 Hz to 10 Hz		25°C		1			1		
V _{NPP}	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	$V_{O} = 0.5 \text{ V to } 2.5 \text{ V},$	A _V = 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 kHz, R _[C _L = 100 pF‡	_ = 10 kΩ [‡] ,	25°C		2.18			2.18		MHz
Вом	Maximum output- swing bandwidth	$V_{O(PP)} = 2 V,$ Av. $R_L = 10 \text{ k}\Omega^{\ddagger},$ Cl	/ = 1, _ = 100 pF [‡]	25°C		1			1		MHz
	Settling time	AV = -1, $Step = 0.5 V to 2.5 V$.		25°C		1.5			1.5		= 6
t _s	Setting 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	$R_L = 10 \text{ k}\Omega^{\ddagger}$, C_l	_ = 100 pF‡	25°C		50°			50°		
	Gain margin			25°C		10			10		dB

[†] Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.



[‡]Referenced to 2.5 V

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

	PARAMETER	TEST COI	NDITIONS	T _A †		LC22720 LC2272 N	,		C2272A C2272A	,	UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
VIO	Input offset voltage			25°C		300	2500		300	950	μV
¥10	Input onset voltage			Full range			3000			1500	μν
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)	$V_{IC} = 0,$ $R_S = 50 \Omega$	$V_O = 0$,	25°C		0.002			0.002		μV/mo
10	Input offset current			25°C		0.5			0.5		pА
-10	input onset dancin			Full range			500			500	P/\
I _{IB}	Input bias current			25°C		1			1		pА
-10	mper oldo odirom			Full range			500			500	P/ \
	Common-mode input	B 50.0	N/	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2		V
VICR	voltage range	$R_S = 50 \Omega$,	V _{IO} ≤5 mV	Full range	-5 to 3.5			-5 to 3.5			
		l _O = -20 μA		25°C		4.99			4.99		
				25°C	4.85	4.93		4.85	4.93		
V _{OM+}	Maximum positive peak output voltage	I _O = -200 μA		Full range	4.85			4.85			V
	output voltage			25°C	4.25	4.65		4.25	4.65		
		$I_O = -1 \text{ mA}$		Full range	4.25			4.25			
		V _{IC} = 0,	I _O = 50 μA	25°C		-4.99			-4.99		
	Maximum manativa maat	V _{IC} = 0,	l _O = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		ĺ
VOM-	Maximum negative peak output voltage	V ₁ C = 0,	- 10 = 300 μA	Full range	-4.85			-4.85			V
		V _{IC} = 0,	$I_{O} = 5 \text{ mA}$	25°C	-3.5	-4.1		-3.5	-4.1		ĺ
		10 - 0,		Full range	-3.5			-3.5			
	Large-signal differential		$R_L = 10 \text{ k}\Omega$	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		
^r id	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,	P package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		130			130		Ω
CMRR	Common-mode rejection	$V_{IC} = -5 \text{ to } 2.7$		25°C	75	80		75	80		dB
CIVINN	ratio	V _O = 0 V,	$R_S = 50 \Omega$	Full range	75			75			uБ
kovo	Supply-voltage rejection	$V_{DD} = \pm 2.2 V$		25°C	80	95		80	95		dB
ksvr	ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	V _{IC} = 0,	No load	Full range	80			80			GD
I _{DD}	Supply current	V _O = 2.5 V,	No load	25°C		2.4	3		2.4	3	mA
ככ	1.6.7]		Full range			3			3	

[†] 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.



TLC227x, TLC227xA Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS SLOS190B – FEBRUARY 1997 – REVISED JULY 1999

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

PA	RAMETER	TEST CONDITI	ONS	T _A †		LC22720 LC2272N	,		C2272A0	,	UNIT
				r	MIN	TYP	MAX	MIN	TYP	MAX	
	Slew rate at	V _O = ±1 V, R _L =	= 10 kΩ,	25°C	2.3	3.6		2.3	3.6		
SR	unity gain	C _L = 100 pF	= 10 KS2,	Full range	1.7			1.7			V/μs
V	Equivalent input	f = 10 Hz		25°C		50			50		nV/√Hz
۷ _n	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		μV
V _{NPP}	equivalent input noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μν
l _n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
	Total harmonic	V _O = ±2.3 V	A _V = 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, C _L = 100 pF	$R_L = 10 \text{ k}\Omega$,	25°C		2.25			2.25		MHz
ВОМ	Maximum output-swing bandwidth	V _O (PP) = 4.6 V, R _L = 10 kΩ,	A _V = 1, C _L = 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 _s	Settling 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 kΩ,	C _L = 100 pF	25°C	52°		52°				
	Gain margin	1		25°C		10			10		dB

[†] Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.

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

	PARAMETER	TEST CON	DITIONS	TAT		_C22740 LC22741	,		C2274A C2274A	,	UNIT
				^	MIN	TYP	MAX	MIN	TYP	MAX	
V	Input offset voltage			25°C		300	2500		300	950	μV
V _{IO}	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)	$V_{DD\pm} = \pm 2.5 \text{ V},$ $V_{O} = 0,$	$V_{IC} = 0$, R _S = 50 Ω	25°C		0.002			0.002		μV/mo
lio	Input offset current			25°C		0.5			0.5		pА
٥	input onset durient			Full range			500			500	P/\
I _{IB}	Input bias current			25°C		1			1		pА
110	Impar blad darront			Full range			500			500	Ρ, .
V _{ICR}	Common-mode input	Rs = 50 Ω,	V _{IO} ≤ 5 mV	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
FICH	voltage range	11.3 - 00 12,	14101 = 9 mr	Full range	0 to 3.5			0 to 3.5			•
		I _{OH} = -20 μA		25°C		4.99			4.99		
	Ulab laval autout	I _{OH} = -200 μA		25°C	4.85	4.93		4.85	4.93		
VOH	High-level output voltage	ΙΟΗ = -200 μΑ		Full range	4.85			4.85			٧
		l _{OH} = −1 mA		25°C	4.25	4.65		4.25	4.65		
				Full range	4.25			4.25			
		$V_{IC} = 2.5 V,$	I _{OL} = 50 μA	25°C		0.01			0.01		
	Low-level output	V _{IC} = 2.5 V,		25°C		0.09	0.15		0.09	0.15	
VOL	voltage	I _{OL} = 500 μA		Full range			0.15			0.15	V
	·	V _{IC} = 2.5 V,	$I_{OL} = 5 \text{mA}$	25°C		0.9	1.5		0.9	1.5	
		10 ,	·	Full range			1.5			1.5	
	Large-signal differential	V _{IC} = 2.5 V,	R _L = 10 kΩ [‡]	25°C	10	35		10	35		
AVD	voltage amplification	V _O = 1 V to 4 V		Full range	10			10			V/mV
			$R_L = 1 M\Omega^{\ddagger}$	25°C		175			175		
^r id	Differential input resistance			25°C		1012			1012		Ω
η	Common-mode input resistance			25°C		1012			1012		Ω
cį	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		140			140		Ω
CMDC	Common-mode	$V_{IC} = 0 \text{ to } 2.7 \text{ V},$		25°C	70	75		70	75		٦D
CMRR	rejection ratio	$V_0 = 2.5 \text{ V},$	$R_S = 50 \Omega$	Full range	70			70			dB
k	Supply-voltage rejection	$V_{DD} = 4.4 \text{ V to 1}$	6,	25°C	80	95		80	95		dB
ksvr	ratio (ΔV _{DD} /ΔV _{IO})	$V_{IC} = V_{DD}/2$	No load	Full range	80			80			ub

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.



[‡]Referenced to 2.5 V

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

PARAMETER		TEST CO	TEST CONDITIONS		TLC2274Q, TLC2274M		TLC2274AQ, TLC2274AM			UNIT	
				T _A †	MIN	TYP	MAX	MIN	TYP	MAX	
	Supply current	V _O = 2.5 V,	No load	25°C		4.4	6		4.4	6	mA
^{'DD}	Зирріу сипепі	VO = 2.5 V,	No load	Full range			6			6	IIIA

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

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

RAMETER	TEST CONDITI	T _A †			,	TLC2274AQ, TLC2274AM			UNIT	
				MIN	TYP	MAX	MIN	TYP	MAX	
Slow rate at unity	V- 05V+025V		25°C	2.3	3.6		2.3	3.6		
gain	$R_L = 10 \text{ k}\Omega^{\ddagger}$, C	L = 100 pF‡	Full range	1.7			1.7			V/μs
Equivalent input	f = 10 Hz		25°C		50			50		nV/√ Hz
noise voltage	f = 1 kHz	:1 kHz 25°C 9			11 V /VHZ					
Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
noise voltage	f = 0.1 Hz to 10 Hz		25°C		1.4			1.4		μ ν
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 _V = 1			0.0013%		-	0.0013%		
distortion plus	f = 20 kHz,	A _V = 10	25°C		0.004%			0.004%		
noise	R _L = 10 kΩ [∓]	A _V = 100			0.03%			0.03%		
Gain-bandwidth product	f = 10 kHz, R C _L = 100 pF‡	$L = 10 \text{ k}\Omega^{\ddagger}$	25°C		2.18			2.18		MHz
Maximum output- swing bandwidth			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		μs
county and	$R_L = 10 \text{ k}\Omega^{\ddagger},$ $C_L = 100 \text{ pF}^{\ddagger}$	To 0.01%	20 0		2.6			2.6		μο
Phase margin at unity gain	$R_L = 10 \text{ k}\Omega^{\ddagger}$, C	L = 100 pF‡	25°C		50°			50°		
Gain margin			25°C		10			10		dB
	Slew rate at unity gain Equivalent input noise voltage Peak-to-peak equivalent input noise voltage Equivalent input noise current Total harmonic distortion plus noise Gain-bandwidth product Maximum outputswing bandwidth Settling time Phase margin at unity gain	Slew rate at unity gain	Slew rate at unity gain	$\begin{array}{c} \text{Slew rate at unity} \\ \text{gain} \end{array} \begin{array}{c} V_{O} = 0.5 \text{ V to } 2.5 \text{ V}, \\ R_{L} = 10 \text{ k}\Omega^{\ddagger}, \end{array} \begin{array}{c} C_{L} = 100 \text{ pF‡} \end{array} \begin{array}{c} \text{Full range} \\ \text{Full range} \end{array}$ $\begin{array}{c} \text{Equivalent input noise voltage} \end{array} \begin{array}{c} \text{f} = 10 \text{ Hz} \\ \text{f} = 1 \text{ kHz} \end{array} \begin{array}{c} 25^{\circ}\text{C} \end{array}$ $\begin{array}{c} \text{Full range} \\ \text{range} \end{array} \begin{array}{c} \text{Equivalent input noise voltage} \end{array} \begin{array}{c} \text{f} = 10 \text{ Hz} \\ \text{f} = 1 \text{ kHz} \end{array} \begin{array}{c} 25^{\circ}\text{C} \end{array}$ $\begin{array}{c} \text{Peak-to-peak equivalent input noise voltage} \end{array} \begin{array}{c} \text{f} = 0.1 \text{ Hz to } 1 \text{ Hz} \end{array} \begin{array}{c} 25^{\circ}\text{C} \end{array}$ $\begin{array}{c} \text{Full range} \end{array} \begin{array}{c} $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{ c c c c c c } \hline \textbf{RAMETER} & \textbf{TEST CONDITIONS} & \textbf{TA}^{\dagger} & \frac{\textbf{TLC2274M}}{\textbf{MIN}} & \textbf{TYP} & \textbf{MAX} & \textbf{MIN} & \textbf{TYP} \\ \hline \textbf{Slew rate at unity gain} & V_O = 0.5 \ V \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	$ \begin{array}{ c c c c c c c c } \hline RAMETER & TEST CONDITIONS & TA^{+} & TLC2274MI & TLC2274MI & MIN & TYP & MAX & MIN & TYP & MAX \\ \hline MIN & TYP & MAX & TIP & TYP & MAX & TIP & T$

[†] Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.

[‡]Referenced to 2.5 V

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

	PARAMETER	TEST CO	ONDITIONS	TAT		_C22740 LC2274	,		C2274A C2274A		UNIT
				^	MIN	TYP	MAX	MIN	TYP	MAX	
V/	languit official valle as			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, R _S = 50 Ω	$V_O = 0$,	25°C		0.002			0.002		μV/mo
I	In	1		25°C		0.5			0.5		A
10	Input offset current			Full range			500			500	рA
1	lanut bina augrant			25°C		1			1		A
lΒ	Input bias current			Full range			500			500	pΑ
VICR	Common-mode input	Bo = 50 O	$ V_{O} \le 5 \text{ mV}$	25°C	-5 to 4	-5.3 to 4.2		-5 to 4	-5.3 to 4.2		٧
VICH .	voltage range	115 = 30 32,	V O = 3 V	Full range	−5 to 3.5			−5 to 3.5			•
		I _O = -20 μA	i.	25°C		4.99			4.99		
	NA : 111 L	l _O = -200 μ	Δ	25°C	4.85	4.93		4.85	4.93		
VOM+	Maximum positive peak output voltage	- 200 μ		Full range	4.85			4.85			V
		l _O = -1 mA		25°C	4.25	4.65		4.25	4.65		
		10 = 1111X		Full range	4.25			4.25			
		$V_{IC} = 0$,	I _O = 50 μA	25°C		-4.99			-4.99		
	Maximum negative peak	V _{IC} = 0,	l _O = 500 μA	25°C	-4.85	-4.91		-4.85	-4.91		
V _{OM} -	output voltage	10 – 9,	.O = 000 p.s. (Full range	-4.85			-4.85			V
		V _{IC} = 0,	IO = 5 mA	25°C	-3.5	-4.1		-3.5	-4.1		
		10 -,		Full range	-3.5			-3.5			
	Large-signal differential		$R_L = 10 \text{ k}\Omega$	25°C	20	50		20	50		
AVD	voltage amplification	$V_0 = \pm 4 \text{ V}$		Full range	20			20			V/mV
			$R_L = 1 M\Omega$	25°C		300			300		
^r id	Differential input resistance			25°C		1012			1012		Ω
rį	Common-mode input resistance			25°C		1012			10 ¹²		Ω
ci	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z _o	Closed-loop output impedance	f = 1 MHz,	A _V = 10	25°C		130			130		Ω
CMDD	Common-mode rejection	V _{IC} = -5 V	to 2.7 V	25°C	75	80		75	80		40
CMRR	ratio	$V_{O} = 0$,	$R_S = 50 \Omega$	Full range	75			75			dB
k :-	Supply-voltage rejection	V _{DD+} = ± 2	.2 V to ±8 V,	25°C	80	95		80	95		al D
ksvr	ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{IC} = 0$,	No load	Full range	80			80			dB

† 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.



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

PARAMETER		TEST CONDITIONS		T _A †	TLC2274Q, TLC2274M			TLC2274AQ, TLC2274AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
	Cumply ourrant	V- 0	No load	25°C		4.8	6		4.8	6	mA
DD	Supply current	$V_O = 0$, No load		Full range			6			6	IIIA

[†] Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.

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

P.	ARAMETER	TEST CONDITION	ONS	T _A †		LC2274Q LC2274N	,		.C2274A0 .C2274A1	,	UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
	Class rate at units	V- +0.2 V D	10.60	25°C	2.3	3.6		2.3	3.6		
SR	Slew rate at unity gain	$V_O = \pm 2.3 \text{ V},$ $C_L = 100 \text{ pF}$	= 10 kΩ,	Full range	1.7			1.7			V/μs
V	Equivalent input	f = 10 Hz		25°C		50			50		NA TIL
V _n	noise voltage	f = 1 kHz		25°C		9			9		nV/√Hz
Vivon	Peak-to-peak	f = 0.1 Hz to 1 Hz		25°C		1			1		μV
V _{N(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	$V_{O} = \pm 2.3 \text{ V}$	A _V = 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 _L : C _L = 100 pF	= 10 kΩ,	25°C		2.25			2.25		MHz
ВОМ	Maximum output-swing bandwidth	V _O (PP) = 4.6 V, A _V = R _L = 10 kΩ, C _L		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 _s	Settling tille	$R_L = 10 \text{ k}\Omega$, $C_L = 100 \text{ pF}$	To 0.01%	25 0		3.2			3.2		μs
φm	Phase margin at unit gain	R _L = 10 kΩ, C _L :	= 100 pF	25°C		52°			52°		
	Gain margin			25°C		10			10		dB

[†] Full range is -40°C to 125°C for Q level part, -55°C to 125°C for M level part.



TYPICAL CHARACTERISTICS

Table of Graphs

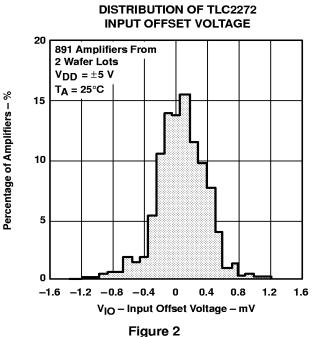
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NOTE: For all graphs where $V_{DD} = 5 \text{ V}$, all loads are referenced to 2.5 V.

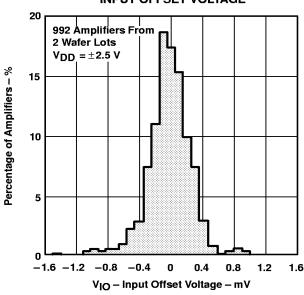


TYPICAL CHARACTERISTICS

DISTRIBUTION OF TLC2272 INPUT OFFSET VOLTAGE 20 891 Amplifiers From 2 Wafer Lots $V_{DD} = \pm 2.5 V$ T_A = 25°C Percentage of Amplifiers – % 15 10 5 -1.6 -1.2 -0.8 -0.40 8.0 1.2 VIO - Input Offset Voltage - mV Figure 1



DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE



DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE

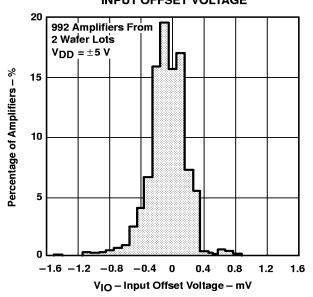


Figure 3

Figure 4

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TYPICAL CHARACTERISTICS

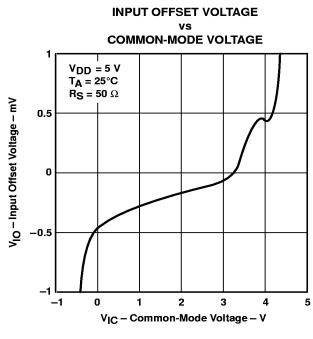


Figure 5

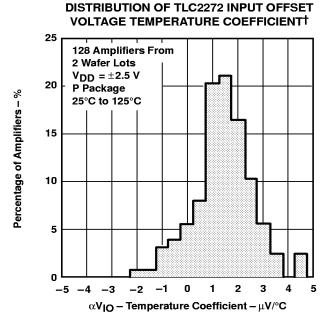
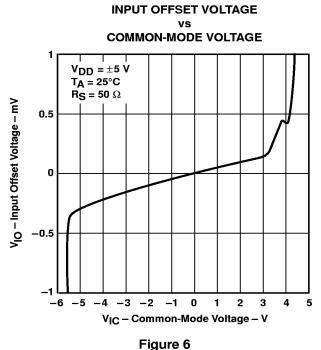


Figure 7



DISTRIBUTION OF TLC2272 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT†

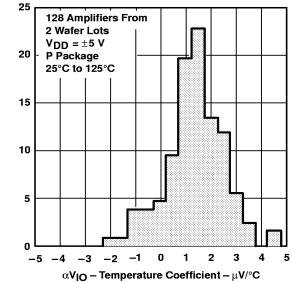


Figure 8

Percentage of Amplifiers – %

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

TYPICAL CHARACTERISTICS

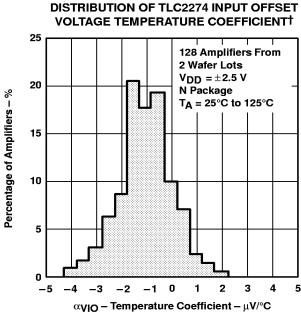
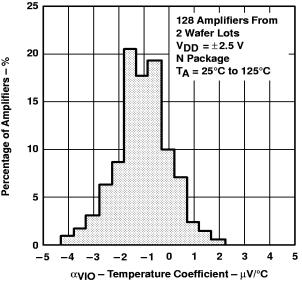


Figure 9



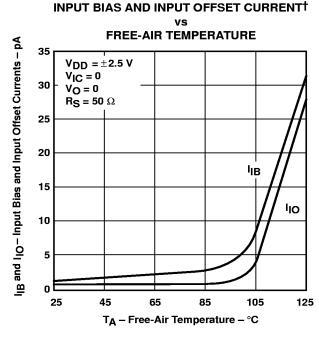


Figure 11

DISTRIBUTION OF TLC2274 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT†

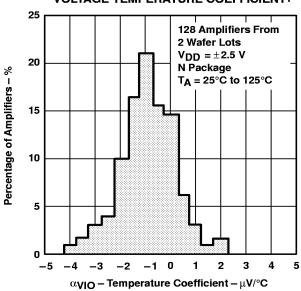
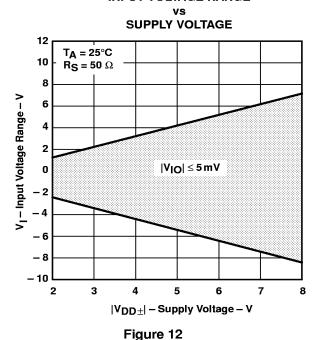


Figure 10

INPUT VOLTAGE RANGE



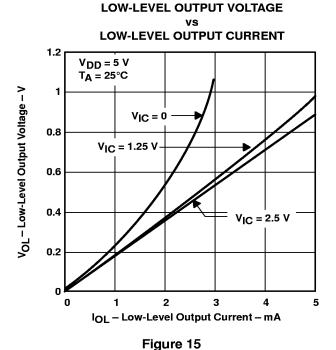
[†] Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



TYPICAL CHARACTERISTICS

V_{OH} - High-Level Output Voltage - V

INPUT VOLTAGE RANGE† FREE-AIR TEMPERATURE $V_{DD} = 5 V$ 4 V_I - Input Voltage Range - V 3 $|V_{\hbox{IO}}| \leq 5\,mV$ 2 0 **-75 -50** - 25 0 25 50 75 100 125 TA - Free-Air Temperature - °C Figure 13



HIGH-LEVEL OUTPUT VOLTAGET
vs
HIGH-LEVEL OUTPUT CURRENT

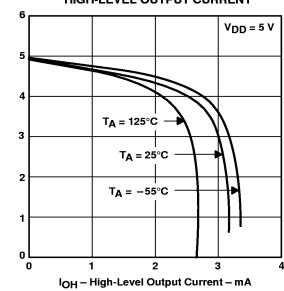


Figure 14

LOW-LEVEL OUTPUT VOLTAGET vs LOW-LEVEL OUTPUT CURRENT

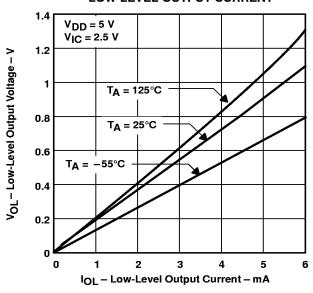


Figure 16

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



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TYPICAL CHARACTERISTICS

OUTPUT CURRENT TA = -55° C TA = 125° C TA = 125° C $|I_{O}|$ - Output Current - mA

MAXIMUM POSITIVE PEAK OUTPUT VOLTAGE[†]

MAXIMUM NEGATIVE PEAK OUTPUT VOLTAGET vs

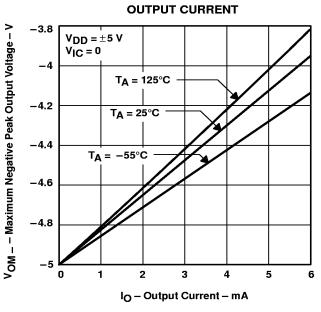
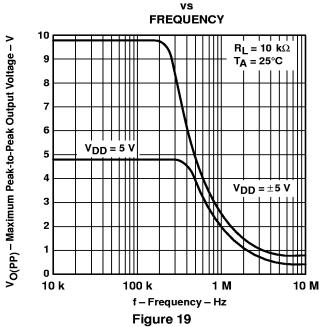
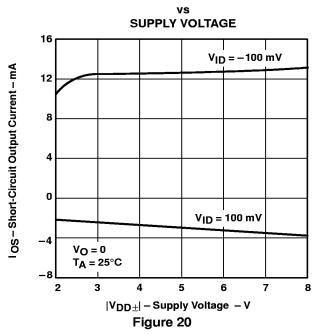


Figure 17 Figure 18

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE



SHORT-CIRCUIT OUTPUT CURRENT



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



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TYPICAL CHARACTERISTICS

SHORT-CIRCUIT OUTPUT CURRENT† FREE-AIR TEMPERATURE 15 $V_O = 0$ $V_{DD} = \pm 5 V$ I OS - Short-Circuit Output Current - mA $V_{ID} = -100 \text{ mV}$ 11 7 -3 $V_{ID} = 100 \text{ mV}$ -75 -50 -25 0 25 50 75 100 125 TA - Free-Air Temperature - °C

Figure 21

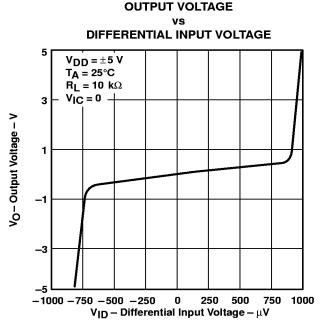


Figure 23

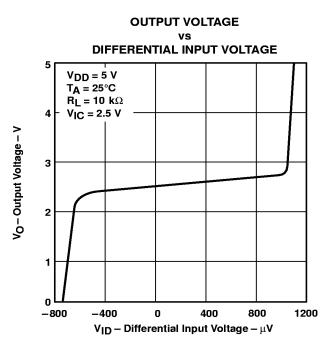
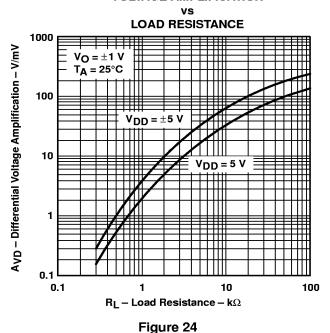


Figure 22

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION



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

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN

vs **FREQUENCY** 80 180° $V_{DD} = 5 V$ $R_L = 10 \text{ k}\Omega$ C_L = 100 pF 135° 60 $T_A = 25^{\circ}C$ A_{VD}- Large-Signal Differential Voltage Amplification – dB 40 90° ^φm – Phase Margin 20 45° 0 0° -20 .45° .90° -40 10 k 100 k 1 M 10 M 1 k

Figure 25

f - Frequency - Hz

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN

vs **FREQUENCY** 80 180° $V_{DD} = \pm 5 V$ $R_L = 10 \text{ k}\Omega$ $C_L = 100 \text{ pF}$ 135° 60 TA = 25°C A_{VD}- Large-Signal Differential Voltage Amplification – dB 90° ^φm − Phase Margin 40 20 45° 0 0° -20 45° -40-90° 100 k 1 k 10 k 1 M 10 M f - Frequency - Hz

Figure 26



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TYPICAL CHARACTERISTICS

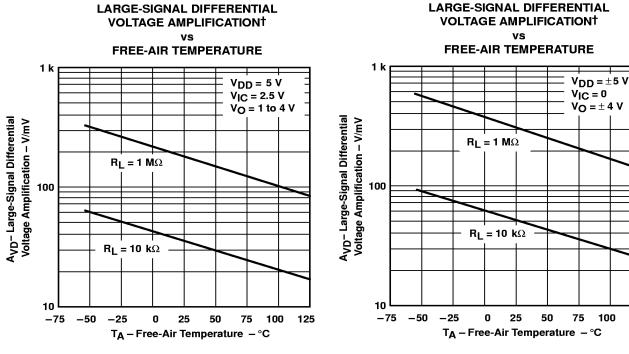


Figure 27

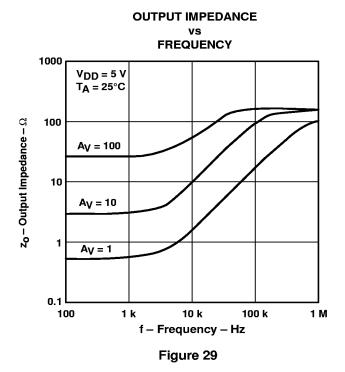
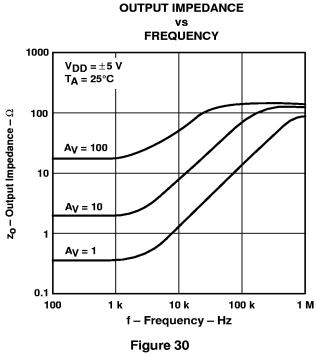


Figure 28



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

125

COMMON-MODE REJECTION RATIO FREQUENCY 100 $T_A = 25$ °C $V_{DD} = \pm 5 V$ $V_{DD} = 5 V$

10 k

100 k

1 M

10 M

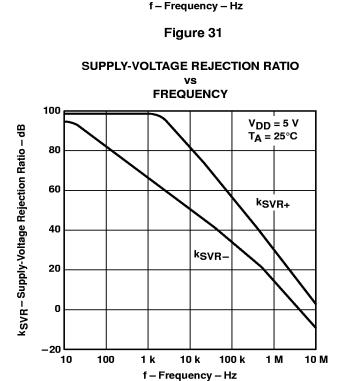


Figure 33

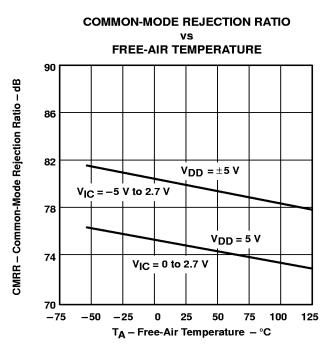


Figure 32

SUPPLY-VOLTAGE REJECTION RATIO

FREQUENCY 100 $V_{DD} = \pm 5 V$ kSVR - Supply-Voltage Rejection Ratio - dB $T_A = 25^{\circ}C$ 80 60 ksvr+ 40 ksvr-20 10 100 1 k 10 k 100 k 1 M 10 M f - Frequency - Hz

Figure 34

CMRR - Common-Mode Rejection Ratio - dB

80

60

40

20

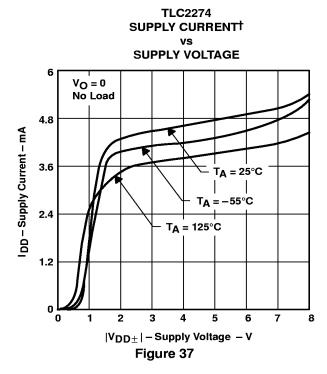
10

100

1 k

SUPPLY VOLTAGE REJECTION RATIO† FREE-AIR TEMPERATURE 110 $V_{DD}^{\pm} = \pm 2.2 \text{ V to } \pm 8 \text{ V}$ kSvR - Supply Voltage Rejection Ratio - dB $V_O = 0$ 105 100 95 90 85 -75 -50 25 75 100 T_A – Free-Air Temperature – °C

Figure 35



TLC2272 SUPPLY CURRENT† vs SUPPLY VOLTAGE

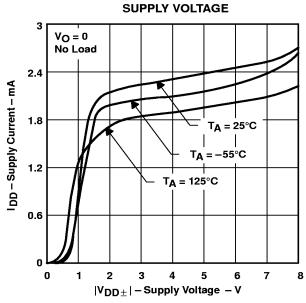
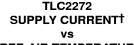
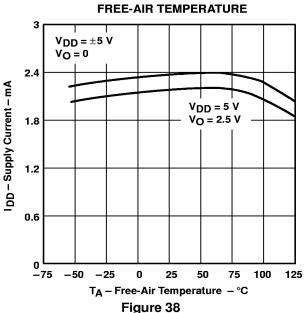
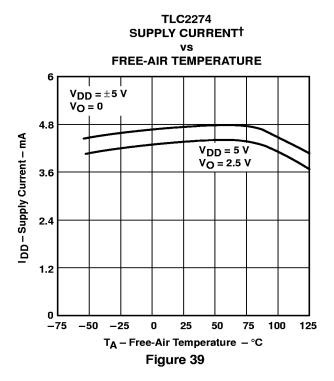


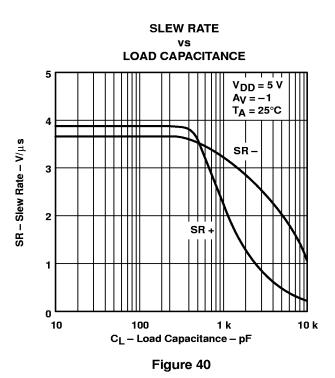
Figure 36

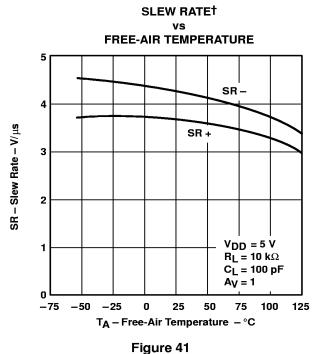




[†] Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.







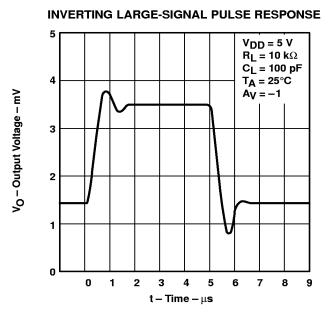


Figure 42

† 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

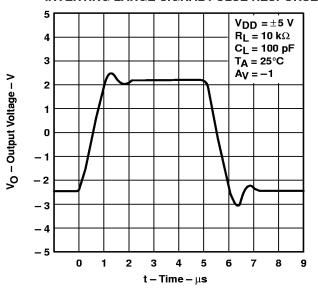


Figure 43

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

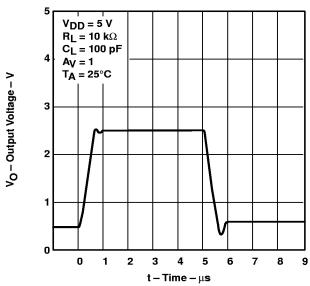


Figure 44

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

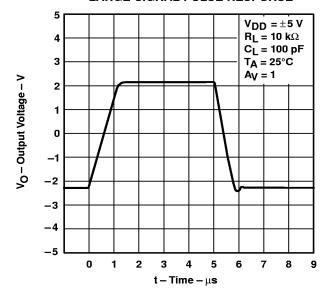


Figure 45

INVERTING SMALL-SIGNAL PULSE RESPONSE

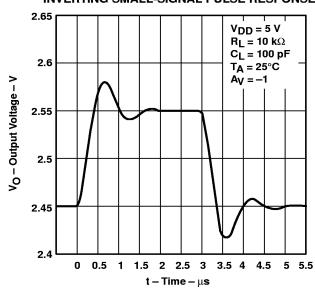


Figure 46

INVERTING SMALL-SIGNAL PULSE RESPONSE 100 $V_{DD} = \pm 5 V$ $R_L = 10 \text{ k}\Omega$ $C_L = 100 pF$ T_A = 25°C $A_V = 1$ Vo - Output Voltage - mV 50 0 -50 -100 0 0.5 1.5 2 2.5 3 3.5

 $t - Time - \mu s$ Figure 47

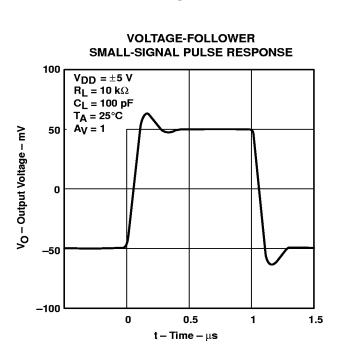


Figure 49

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

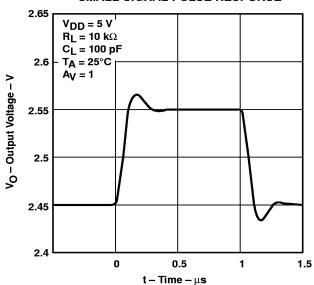


Figure 48

EQUIVALENT INPUT NOISE VOLTAGE

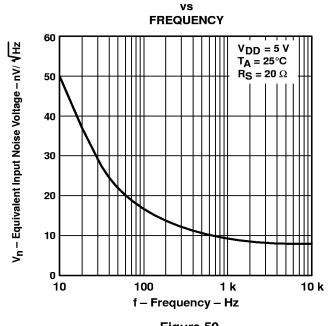


Figure 50

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TYPICAL CHARACTERISTICS

EQUIVALENT INPUT NOISE VOLTAGE

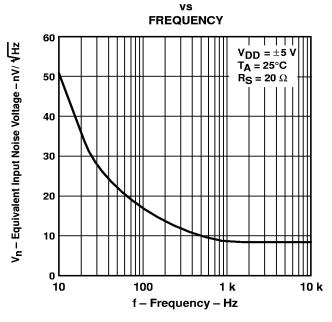


Figure 51

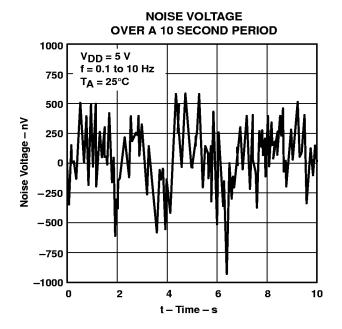


Figure 52

INTEGRATED NOISE VOLTAGE

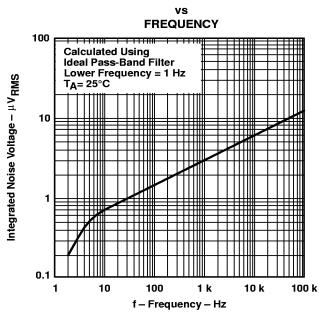


Figure 53

TOTAL HARMONIC DISTORTION PLUS NOISE

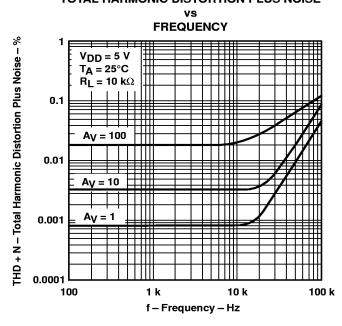
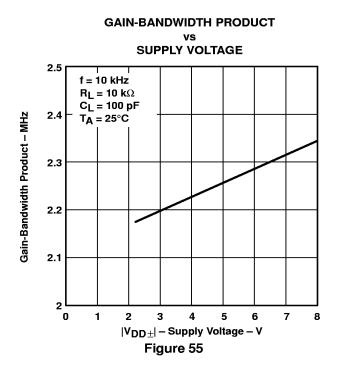
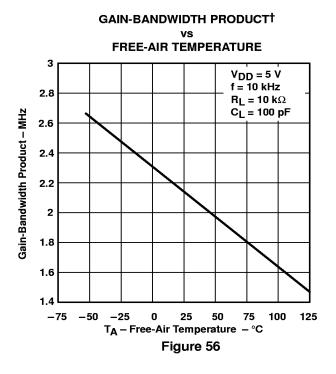
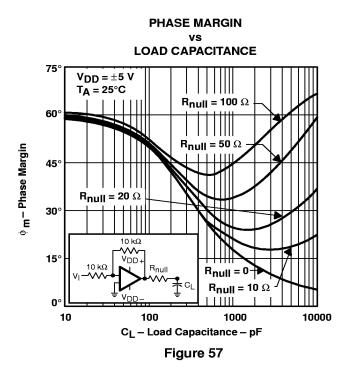
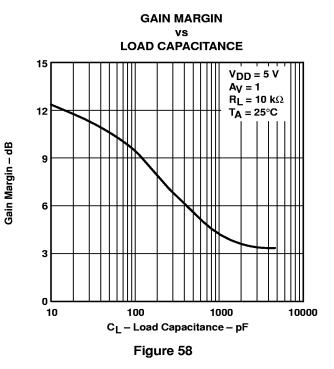


Figure 54









[†] 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™, the model generation software used with Microsim PSpice™. The Boyle macromodel (see Note 5) and subcircuit in Figure 59 were generated using the TLC227x typical electrical and operating characteristics at $T_A = 25$ °C. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

- Maximum positive output voltage swing
- Maximum negative output voltage swing
- Slew rate
- Quiescent power dissipation
- Input bias current
- Open-loop voltage amplification

- Unity gain frequency
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

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

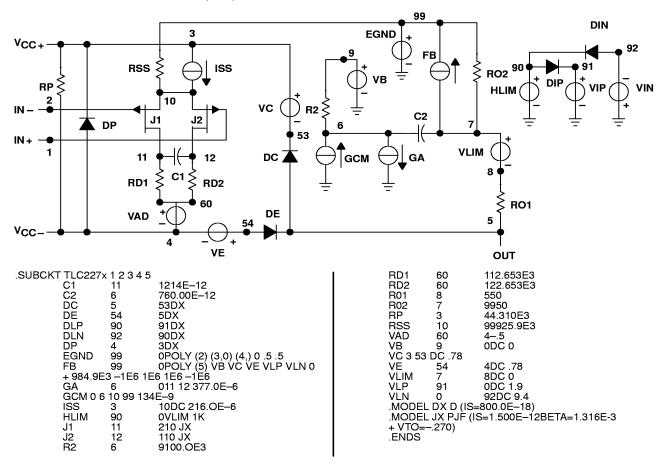


Figure 59. Boyle Macromodel and Subcircuit

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

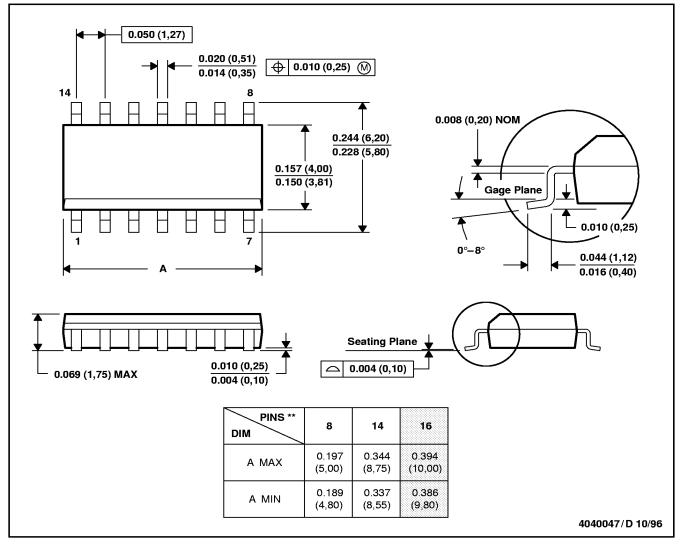
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MECHANICAL DATA

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PIN SHOWN



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).

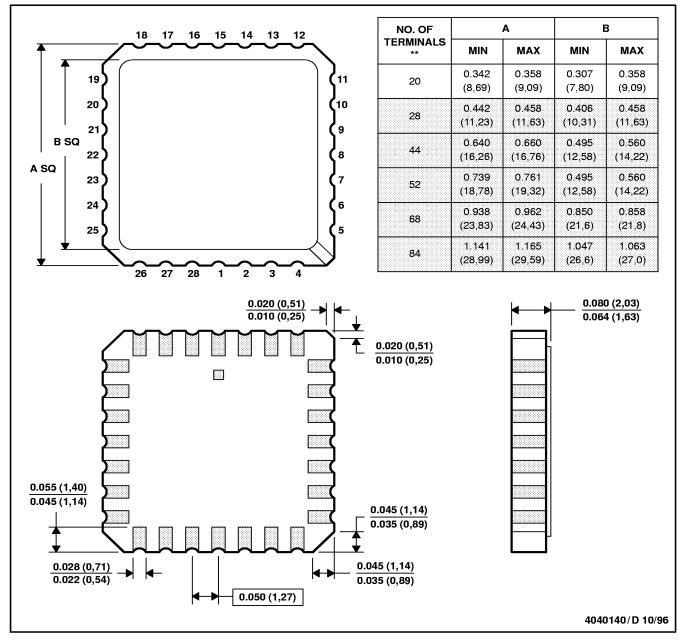
D. Falls within JEDEC MS-012



FK (S-CQCC-N**)

28 TERMINAL SHOWN

LEADLESS CERAMIC CHIP CARRIER



NOTES: A. All linear dimensions are in inches (millimeters).

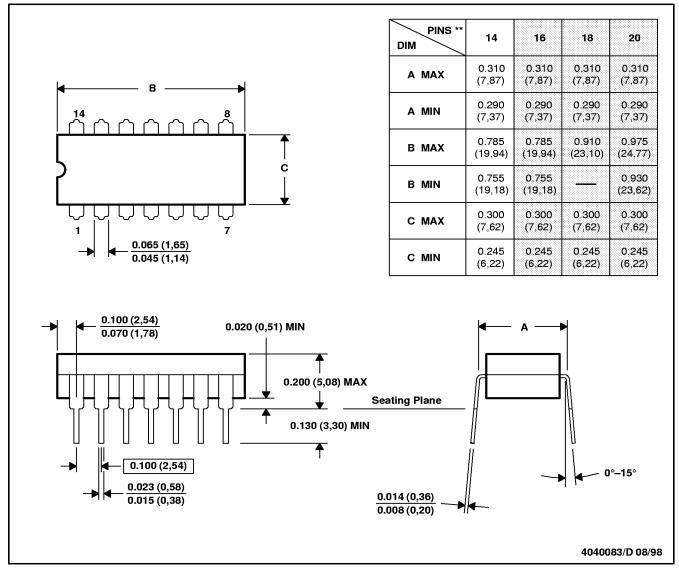
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a metal lid.
- D. The terminals are gold plated.
- E. Falls within JEDEC MS-004



J (R-GDIP-T**)

14 PIN SHOWN

CERAMIC DUAL-IN-LINE PACKAGE



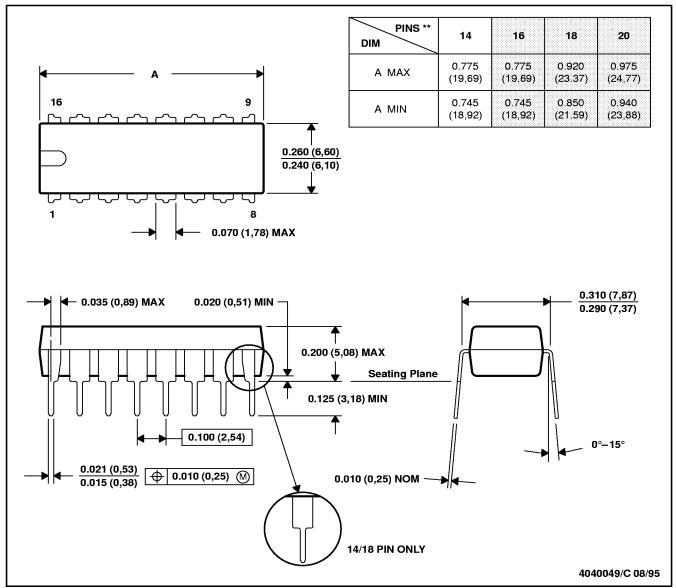
- NOTES: A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18, GDIP1-T20, and GDIP1-T22.



N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PIN SHOWN



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

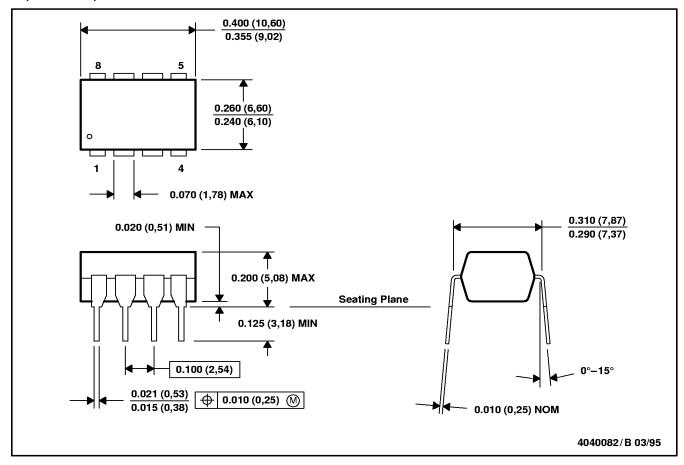
C. Falls within JEDEC MS-001 (20 pin package is shorter then MS-001.)

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MECHANICAL DATA

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



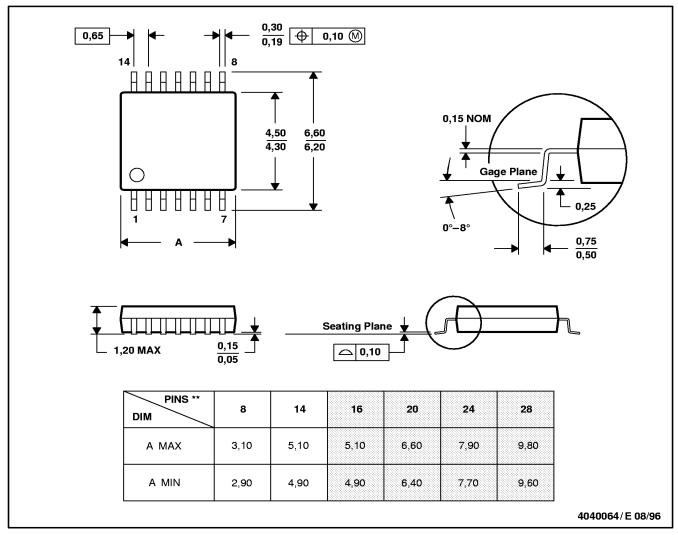
NOTES: A. All linear dimensions are in inches (millimeters).

- B. This drawing is subject to change without notice.
- C. Falls within JEDEC MS-001

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PIN SHOWN



NOTES: A. All linear dimensions are in millimeters.

B. This drawing is subject to change without notice.

C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.

D. Falls within JEDEC MO-153

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