- **Output Swing includes Both Supply Rails**
- **Low Noise . . . 12 nV/√Hz Typ at f = 1 kHz**
- **Low Input Bias Current . . . 1 pA Typ**
- **Fully Specified for Both Single-Supply and Split-Supply Operation**
- **Low Power . . . 500 µA Max**
- **Common-Mode Input Voltage Range Includes Negative Rail**
- **Low Input Offset Voltage** **950 µV Max at T_A = 25°C (TLC2262A)**
- **Macromodel Included**
- **Performance Upgrade for the TS27M2/M4 and TLC27M2/M4**

description

The TLC2262 and TLC2264 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 TLC226x family offers a compromise between the micropower TLC225x and the ac performance of the TLC227x. It has low supply current for battery-powered applications, while still having adequate ac performance for applications that demand it. The noise performance has been dramatically improved over previous generations of CMOS amplifiers. Figure 1 depicts the low level of noise voltage for this CMOS amplifier, which has only 200 µA (typ) of supply current per amplifier.

EQUIVALENT INPUT NOISE VOLTAGE
vs
FREQUENCY

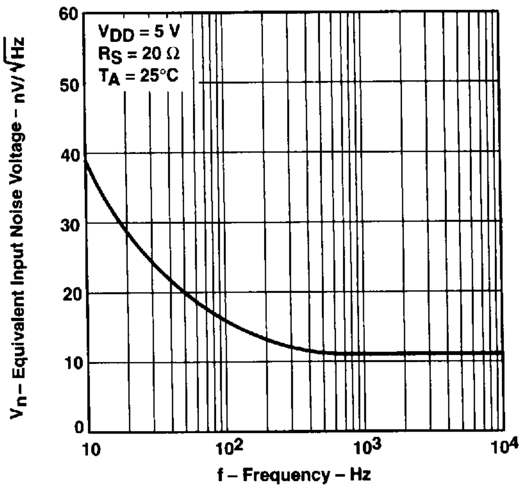


Figure 1

The TLC226x, exhibiting high input impedance and low noise, are excellent for small-signal conditioning for high-impedance sources, such as piezoelectric transducers. Because of the micro-power dissipation levels, these devices work well in hand-held monitoring and remote-sensing applications. In addition, the rail-to-rail output feature with single or split supplies makes this family a great choice when interfacing with analog-to-digital converters (ADCs). For precision applications, the TLC226xA family is available and has a maximum input offset voltage of 950 µV. This family is fully characterized at 5 V and ±5 V.

The TLC2262/4 also makes great upgrades to the TLC27M2/L4 or TS27M2/L4 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. If your 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.

TLC2262 AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES						CHIP FORM (Y)
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	TSSOP (PW)	CERAMIC FLATPACK (U)	
0°C to 70°C	2.5 mV	TLC2262CD	—	—	TLC2262CP	TLC2262CPWLE	—	TLC2262Y
−40°C to 125°C	950 µV 2.5 mV	TLC2262AID TLC2262ID	— —	— —	TLC2262AIP TLC2262IP	TLC2262AIPWLE —	— —	
−55°C to 125°C	950 µV 2.5 mV	— —	TLC2262AMFK TLC2262MFK	TLC2262AMJG TLC2262MJG	— —	— —	TLC2262AMU TLC2262MU	

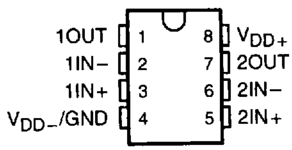
The D packages are available taped and reeled. Add R suffix to device type (e.g., TLC2262CDR). The PW package is available only left-end taped and reeled. Chips are tested at 25°C.

TLC2264 AVAILABLE OPTIONS

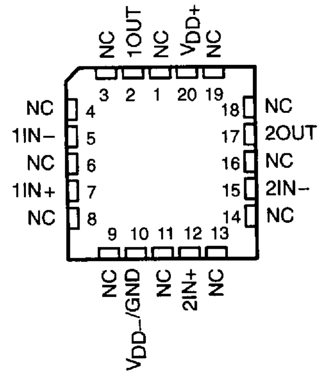
T_A	V_{IO}max AT 25°C	PACKAGED DEVICES						CHIP FORM (Y)
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	TSSOP (PW)	CERAMIC FLATPACK (W)	
0°C to 70°C	2.5 mV	TLC2264CD	—	—	TLC2264CN	TLC2264CPWLE	—	TLC2262Y
−40°C to 125°C	950 µV 2.5 mV	TLC2264AID TLC2264ID	— —	— —	TLC2264AIN TLC2264IN	TLC2264AIPWLE —	— —	
−55°C to 125°C	950 µV 2.5 mV	— —	TLC2264AMFK TLC2264MFK	TLC2264AMJ TLC2264MJ	— —	— —	TLC2264AMW TLC2264MW	

The D packages are available taped and reeled. Add R suffix to device type (e.g., TLC2264CDR). The PW package is available only left-end taped and reeled. Chips are tested at 25°C.

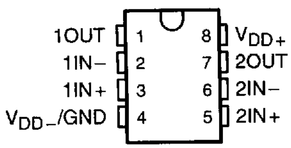
TLC2262C, TLC2262AC
TLC2262I, TLC2262AI
D, P, OR PW PACKAGE
(TOP VIEW)



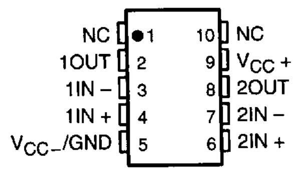
TLC2262M, TLC2262AM . . . FK PACKAGE
(TOP VIEW)



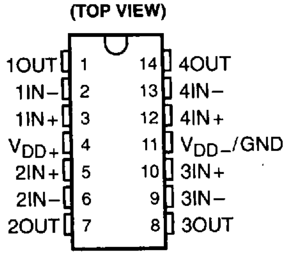
TLC2262M, TLC2262AM . . . JG PACKAGE
(TOP VIEW)



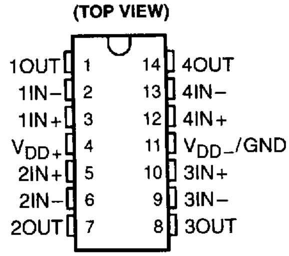
TLC2262M, TLC2262AM . . . U PACKAGE
(TOP VIEW)



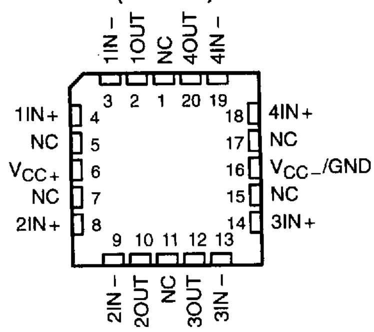
TLC2264C, TLC2264AC
TLC2264I, TLC2264AI
D, N, OR PW PACKAGE
(TOP VIEW)



TLC2264M, TLC2264AM . . . J OR W PACKAGE
(TOP VIEW)



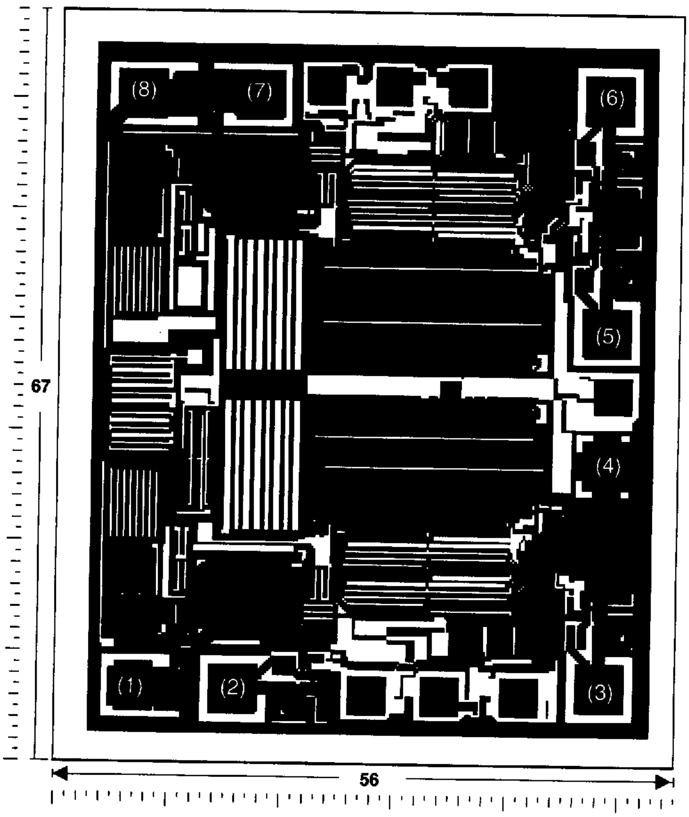
TLC2264M, TLC2264AM . . . FK PACKAGE
(TOP VIEW)

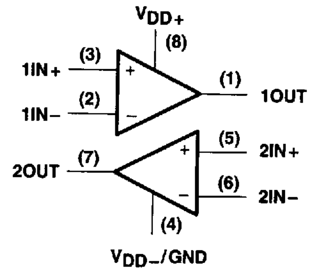


TLC2262Y chip information

This chip, when properly assembled, displays characteristics similar to the TLC2262C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. This chip may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 15 MILS TYPICAL

BONDING PADS: 4 × 4 MILS MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

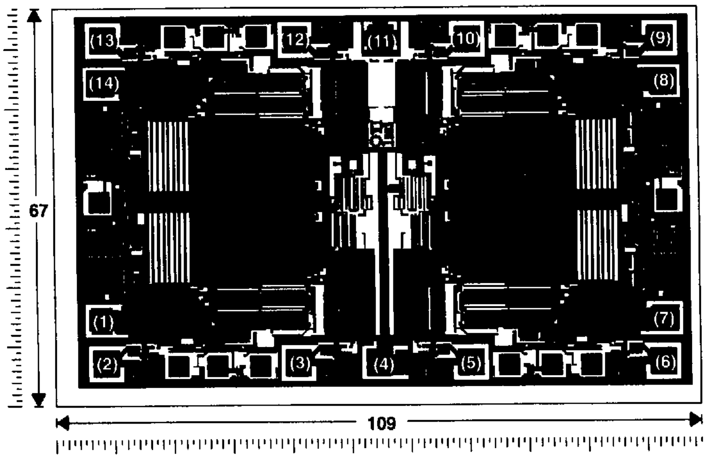
ALL DIMENSIONS ARE IN MILS.

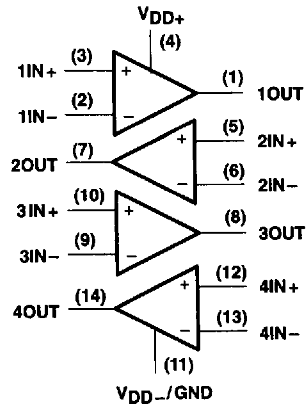
PIN (4) IS INTERNALLY CONNECTED TO BACKSIDE OF CHIP.

TLC2264Y chip information

This chip, when properly assembled, displays characteristics similar to the TLC2264C. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. This chip may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 15 MILS TYPICAL

BONDING PADS: 4 × 4 MILS MINIMUM

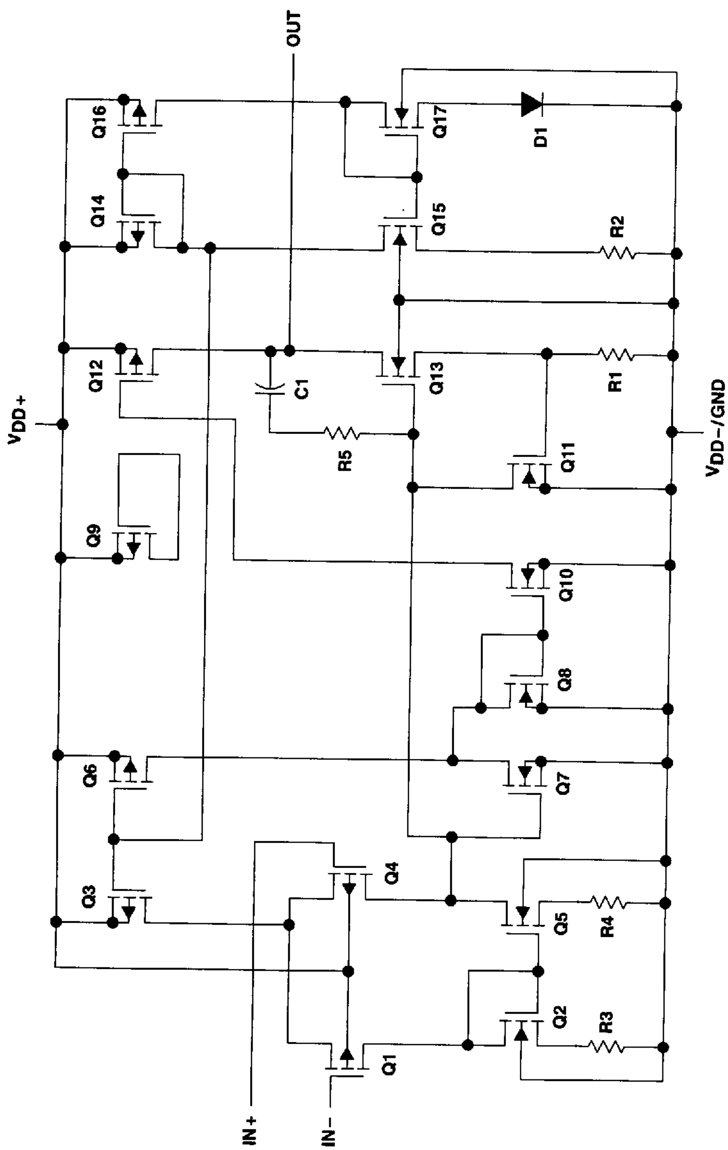
$T_J max = 150°C$

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

PIN (11) IS INTERNALLY CONNECTED TO BACKSIDE OF THE CHIP.

equivalent schematic (each amplifier)



ACTUAL DEVICE COMPONENT COUNT†		
COMPONENT	TLC2262	TLC2264
Transistors	38	76
Resistors	28	56
Diodes	9	18
Capacitors	3	6

† 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) .... 8 V
Supply voltage, V_{DD-} (see Note 1) .... –8 V
Differential input voltage, V_{ID} (see Note 2) .... ±16 V
Input voltage, V_I (any input, see Note 1) .... V_{DD-} – 0.3 V to V_{DD+}
Input current, I_I (each input) .... ±5 mA
Output current, I_O .... ±50 mA
Total current into V_{DD+} .... ±50 mA
Total current out of V_{DD-} .... ±50 mA
Duration of short-circuit current at (or below) 25°C (see Note 3) .... unlimited
Continuous total dissipation .... See Dissipation Rating Table
Operating free-air temperature range, T_A: C suffix .... 0°C to 70°C
I suffix .... –40°C to 125°C
M suffix .... –55°C to 125°C
Storage temperature range, T_{stg} .... –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, N, P, and PW packages .... 260°C
J, JG, U, and W packages .... 300°C

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

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

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ 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	377 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
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW	230 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW
PW–8	525 mW	4.2 mW/°C	336 mW	273 mW	105 mW
PW–14	700 mW	5.6 mW/°C	448 mW	364 mW	140 mW
U	700 mW	5.5 mW/°C	452 mW	370 mW	150 mW
W	700 mW	5.5 mW/°C	452 mW	370 mW	150 mW

recommended operating conditions

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

TLC2262C electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2262C MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0,	$V_{DD}\pm$ = ±2.5 V, R_S = 50 Ω	25°C		300	2500	µV
				Full range			3000	
α_{VIO}	Temperature coefficient of input offset voltage			25°C to 70°C		2		µV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003		µV/mo
I_{IO}	Input offset current			25°C		0.5		pA
				Full range			100	
I_{IB}	Input bias current			25°C		1		pA
				Full range			100	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω,	$\lvert V_{IO}\rvert \le$ 5 mV	25°C	0 to 4	−0.3 to 4.2		V
				Full range	0 to 3.5			
V_{OH}	High-level output voltage	I_{OH} = −20 µA		25°C		4.99		V
		I_{OH} = −100 µA		25°C	4.85	4.94		
				Full range	4.82			
		I_{OH} = −400 µA		25°C	4.70	4.85		
				Full range	4.60			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 µA	25°C		0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 µA	25°C		0.09	0.15	
				Full range			0.15	
		V_{IC} = 2.5 V,	I_{OL} = 1 mA	25°C		0.2	0.3	
				Full range			0.3	
		V_{IC} = 2.5 V,	I_{OL} = 4 mA	25°C		0.7	1	
				Full range			1.2	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ‡	25°C	80	170		V/mV
				Full range	55			
			R_L = 1 MΩ‡	25°C		550		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, R_S = 50 Ω	V_O = 2.5 V,	25°C	70	83		dB
				Full range	70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V, V_{IC} = V_{DD}/2,	No load	25°C	80	95		dB
				Full range	80			
I_{DD}	Supply current	V_O = 2.5 V,	No load	25°C		400	500	µA
				Full range			500	

† Full range is 0°C to 70°C.
‡ Referenced to 2.5 V
NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

TLC2262C operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLC2262C MIN	TLC2262C TYP	TLC2262C MAX	UNIT
SR	Slew rate at unity gain	V_O = 1.5 V to 3.5 V, C_L = 100 pF‡	R_L = 50 kΩ‡,	25°C	0.35	0.55		V/µs
				Full range	0.3			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		40		nV/√Hz
		f = 1 kHz		25°C		12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.7		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3		
I_n	Equivalent input noise current			25°C		0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, f = 20 kHz, R_L = 50 kΩ‡	A_V = 1	25°C		0.017%		
			A_V = 10			0.03%		
	Gain-bandwidth product	f = 10 kHz, C_L = 100 pF‡	R_L = 50 kΩ‡,	25°C		0.71		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, R_L = 50 kΩ‡,	A_V = 1, C_L = 100 pF‡	25°C		185		kHz
t_s	Settling time	A_V = −1, Step = 0.5 V to 2.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡	To 0.1%	25°C		6.4		µs
			To 0.01%			14.1		
ϕ_m	Phase margin at unity gain	R_L = 50 kΩ‡,	C_L = 100 pF‡	25°C		56°		
	Gain margin			25°C		11		dB

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

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TLC2262C electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm5$ V (unless otherwise specified)

PARAMETER		TEST CONDITIONS		T_A†	TLC2262C MIN	TLC2262C TYP	TLC2262C MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$, $R_S = 50\ \Omega$		25°C		300	2500	μV
				Full range			3000	
α_{VIO}	Temperature coefficient of input offset voltage			25°C to 70°C		2		μV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003		μV/mo
I_{IO}	Input offset current			25°C		0.5		pA
				Full range			100	
I_{IB}	Input bias current			25°C		1		pA
				Full range			100	
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\| \le 5$ mV, $R_S = 50\ \Omega$		25°C	−5 to 4	−5.3 to 4.2		V
				Full range	−5 to 3.5			
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$		25°C		4.99		V
		$I_O = -100\ \mu A$		25°C	4.85	4.94		
				Full range	4.82			
		$I_O = -400\ \mu A$		25°C	4.7	4.85		
				Full range	4.6			
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$,	$I_O = 50\ \mu A$	25°C		−4.99		V
		$V_{IC} = 0$,	$I_O = 500\ \mu A$	25°C	−4.85	−4.91		
				Full range	−4.85			
		$V_{IC} = 0$,	$I_O = 1$ mA	25°C	−4.7	−4.8		
				Full range	−4.7			
		$V_{IC} = 0$,	$I_O = 4$ mA	25°C	−4	−4.3		
				Full range	−3.8			
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm4$ V	$R_L = 50\ k\Omega$	25°C	80	200		V/mV
				Full range	55			
			$R_L = 1\ M\Omega$	25°C		1000		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	$A_V = 10$	25°C		220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V, $V_O = 0$ V, $R_S = 50\ \Omega$		25°C	75	88		dB
				Full range	75			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = 2.2$ V to ±8 V, $V_{IC} = 0$, No load		25°C	80	95		dB
				Full range	80			
I_{DD}	Supply current	$V_O = 0$ V,	No load	25°C		425	500	μA
				Full range			500	

† Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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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TLC2262C operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V

PARAMETER		TEST CONDITIONS		T_A†	TLC2262C MIN	TLC2262C TYP	TLC2262C MAX	UNIT
SR	Slew rate at unity gain	$V_O = \pm 1.9$ V, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C	0.35	0.55		V/μs
				Full range	0.3			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		43		nV/√Hz
		f = 1 kHz		25°C		12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.8		μV
		f = 0.1 Hz to 10 Hz		25°C		1.3		
I_n	Equivalent input noise current			25°C		0.6		fA√Hz
THD + N	Total harmonic distortion pulse duration	$V_O = \pm 2.3$ V, f = 20 kHz, $R_L = 50$ kΩ	$A_V = 1$	25°C		0.014%		
			$A_V = 10$			0.024%		
	Gain-bandwidth product	f = 10 kHz, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C		0.73		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6$ V, $R_L = 50$ kΩ,	$A_V = 1$, $C_L = 100$ pF	25°C		85		kHz
t_s	Settling time	$A_V = -1$, Step = −2.3 V to 2.3 V, $R_L = 50$ kΩ, $C_L = 100$ pF	To 0.1%	25°C		7.1		μs
			To 0.01%			16.5		
ϕ_m	Phase margin at unity gain	$R_L = 50$ kΩ,	$C_L = 100$ pF	25°C		57°		
	Gain margin			25°C		11		dB

† Full range is 0°C to 70°C.

TLC2264C electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2264C MIN	TLC2264C TYP	TLC2264C MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω	25°C		300	2500	µV
				Full range			3000	
α_{VIO}	Temperature coefficient of input offset voltage			25°C to 70°C		2		µV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003		µV/mo
I_{IO}	Input offset current			25°C		0.5		pA
				Full range			100	
I_{IB}	Input bias current			25°C		1		pA
				Full range			100	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω,	$\|V_{IO}\| \le$ 5 mV	25°C	0 to 4	−0.3 to 4.2		V
				Full range	0 to 3.5			
V_{OH}	High-level output voltage	I_{OH} = −20 µA		25°C		4.99		V
		I_{OH} = −100 µA		25°C	4.85	4.94		
				Full range	4.82			
		I_{OH} = −400 µA		25°C	4.70	4.85		
				Full range	4.60			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 µA	25°C		0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 µA	25°C		0.09	0.15	
				Full range			0.15	
		V_{IC} = 2.5 V,	I_{OL} = 1 mA	25°C		0.2	0.3	
				Full range			0.3	
		V_{IC} = 2.5 V,	I_{OL} = 4 mA	25°C		0.7	1	
				Full range			1.2	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ‡	25°C	80	170		V/mV
				Full range	55			
			R_L = 1 MΩ‡	25°C		550		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, R_S = 50 Ω	V_O = 2.5 V,	25°C	70	83		dB
				Full range	70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V, V_{IC} = V_{DD}/2,	No load	25°C	80	95		dB
				Full range	80			
I_{DD}	Supply current (four amplifiers)	V_O = 2.5 V,	No load	25°C		0.8	1	mA
				Full range			1	

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

NOTE 4. Typical values are based on the input offset voltage shift observed through 500 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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TLC2264C operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLC2264C MIN	TLC2264C TYP	TLC2264C MAX	UNIT
SR	Slew rate at unity gain	V_O = 1.4 V to 2.6 V, C_L = 100 pF‡	R_L = 50 kΩ‡,	25°C	0.35	0.55		V/µs
				Full range	0.3			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		40		nV/√Hz
		f = 1 kHz		25°C		12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.7		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3		
I_n	Equivalent input noise current			25°C		0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, f = 20 kHz, R_L = 50 kΩ‡	A_V = 1	25°C		0.017%		
			A_V = 10			0.03%		
	Gain-bandwidth product	f = 10 kHz, C_L = 100 pF‡	R_L = 50 kΩ‡,	25°C		0.71		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, R_L = 50 kΩ‡,	A_V = 1, C_L = 100 pF‡	25°C		185		kHz
t_s	Settling time	A_V = −1, Step = 0.5 V to 2.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡	To 0.1%	25°C		6.4		µs
			To 0.01%			14.1		
ϕ_m	Phase margin at unity gain	R_L = 50 kΩ‡,	C_L = 100 pF‡	25°C		56°		
	Gain margin			25°C		11		dB

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

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TLC2264C electrical characteristics at specified free-air temperature, $V_{DD\pm}$ = ±5 V (unless otherwise specified)

PARAMETER		TEST CONDITIONS		T_A†	TLC2264C MIN	TLC2264C TYP	TLC2264C MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	V_O = 0,	25°C		300	2500	μV
				Full range			3000	
α_{VIO}	Temperature coefficient of input offset voltage			25°C to 70°C		2		μV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003		μV/mo
I_{IO}	Input offset current			25°C		0.5		pA
				Full range			100	
I_{IB}	Input bias current			25°C		1		pA
				Full range			100	
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\|$ ≤ 5 mV,	R_S = 50 Ω	25°C	−5 to 4	−5.3 to 4.2		V
				Full range	−5 to 3.5			
V_{OM+}	Maximum positive peak output voltage	I_O = −20 μA		25°C		4.99		V
		I_O = −100 μA		25°C	4.85	4.94		
				Full range	4.82			
		I_O = −400 μA		25°C	4.7	4.85		
				Full range	4.6			
V_{OM-}	Maximum negative peak output voltage	V_{IC} = 0,	I_O = 50 μA	25°C		−4.99		V
		V_{IC} = 0,	I_O = 500 μA	25°C	−4.85	−4.91		
				Full range	−4.85			
		V_{IC} = 0,	I_O = 1 mA	25°C	−4.7	−4.8		
				Full range	−4.7			
		V_{IC} = 0,	I_O = 4 mA	25°C	−4	−4.3		
				Full range	−3.8			
A_{VD}	Large-signal differential voltage amplification	V_O = ±4 V	R_L = 50 kΩ	25°C	80	200		V/mV
				Full range	55			
			R_L = 1 MΩ	25°C		1000		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		220		Ω
CMRR	Common-mode rejection ratio	V_{IC} = −5 V to 2.7 V, V_O = 0,	R_S = 50 Ω	25°C	75	88		dB
				Full range	75			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm}$ = ±2.2 V to ±8 V, V_{IC} = 0,	No load	25°C	80	95		dB
				Full range	80			
I_{DD}	Supply current (four amplifiers)	V_O = 0,	No load	25°C		0.85	1	mA
				Full range			1	

† Full range is 0°C to 70°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

TLC2264C operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V

PARAMETER		TEST CONDITIONS		T_A†	TLC2264C MIN	TLC2264C TYP	TLC2264C MAX	UNIT
SR	Slew rate at unity gain	$V_O = \pm 1.9$ V, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C	0.35	0.55		V/µs
				Full range	0.3			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		43		nV/√Hz
		f = 1 kHz		25°C		12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.8		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3		
I_n	Equivalent input noise current			25°C		0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3$ V, f = 20 kHz, $R_L = 50$ kΩ	$A_V = 1$	25°C		0.014%		
			$A_V = 10$			0.024%		
	Gain-bandwidth product	f = 10 kHz, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C		0.73		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6$ V, $R_L = 50$ kΩ,	$A_V = 1$, $C_L = 100$ pF	25°C		70		kHz
t_s	Settling time	$A_V = -1$, Step = −2.3 V to 2.3 V, $R_L = 50$ kΩ, $C_L = 100$ pF	To 0.1%	25°C		7.1		µs
			To 0.01%			16.5		
ϕ_m	Phase margin at unity gain	$R_L = 50$ kΩ,	$C_L = 100$ pF	25°C		57°		
	Gain margin			25°C		11		dB

† Full range is 0°C to 70°C.

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TLC2262I electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2262I MIN	TLC2262I TYP	TLC2262I MAX	TLC2262AI MIN	TLC2262AI TYP	TLC2262AI MAX	UNIT
V_{IO}	Input offset voltage	$V_{DD\pm}$ = ±2.5 V, V_{IC} = 0, V_O = 0, R_S = 50 Ω		25°C		300	2500		300	950	µV
				Full range			3000			1500	
α_{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)			25°C		0.003			0.003		µV/mo
I_{IO}	Input offset current			25°C		0.5			0.5		pA
				Full range			500			500	
I_{IB}	Input bias current			25°C		1			1		pA
				Full range			500			500	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω, $\lvert V_{IO}\rvert$ ≤ 5 mV		25°C	0 to 4	−0.3 to 4.2		0 to 4	−0.3 to 4.2		V
				Full range	0 to 3.5			0 to 3.5			
V_{OH}	High-level output voltage	I_{OH} = −20 µA		25°C		4.99			4.99		V
		I_{OH} = −100 µA		25°C	4.85	4.94		4.85	4.94		
				Full range	4.82			4.82			
		I_{OH} = −400 µA		25°C	4.7	4.85		4.7	4.85		
				Full range	4.5			4.5			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 µA	25°C		0.01			0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 µA	25°C		0.09	0.15		0.09	0.15	
				Full range			0.15			0.15	
		V_{IC} = 2.5 V,	I_{OL} = 4 mA	25°C		0.8	1		0.7	1	
				Full range			1.2			1.2	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ‡	25°C	80	100		80	170		V/mV
				Full range	50			50			
			R_L = 1 MΩ‡	25°C		550			550		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		240			240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, R_S = 50 Ω	V_O = 2.5 V,	25°C	70	83		70	83		dB
				Full range	70			70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V, V_{IC} = V_{DD}/2,	No load	25°C	80	95		80	95		dB
				Full range	80			80			
I_{DD}	Supply current	V_O = 2.5 V,	No load	25°C		400	500		400	500	µA
				Full range			500			500	

† Full range is – 40°C to 125°C.
‡ Referenced to 2.5 V

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

TLC2262I operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLC2262I MIN	TLC2262I TYP	TLC2262I MAX	TLC2262AI MIN	TLC2262AI TYP	TLC2262AI MAX	UNIT
SR	Slew rate at unity gain	V_O = 1.5 V to 3.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C	0.35	0.55		0.35	0.55		V/µs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		40			40		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.7			0.7		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, f = 20 kHz, R_L = 50 kΩ‡	A_V = 1	25°C		0.017%			0.017%		
			A_V = 10			0.03%			0.03%		
	Gain-bandwidth product	f = 50 kHz, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		0.82			0.82		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, R_L = 50 kΩ‡, A_V = 1, C_L = 100 pF‡		25°C		185			185		kHz
t_s	Settling time	A_V = –1, Step = 0.5 V to 2.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡	To 0.1%	25°C		6.4			6.4		µs
			To 0.01%			14.1			14.1		
ϕ_m	Phase margin at unity gain	R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		56°			56°		
	Gain margin			25°C		11			11		dB

† Full range is – 40°C to 125°C.
‡ Referenced to 2.5 V

TLC2262I electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLC2262I MIN	TLC2262I TYP	TLC2262I MAX	TLC2262AI MIN	TLC2262AI TYP	TLC2262AI MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$, $R_S = 50\ \Omega$	25°C		300	2500		300	950	µV
			Full range			3000			1500	
α_{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)		25°C		0.003			0.003		µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			500			500	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			500			500	
V_{ICR}	Common-mode input voltage range	$R_S = 50\ \Omega$, $\lvert V_{IO} \rvert \le 5$ mV	25°C	−5 to 4	−5.3 to 4.2		−5 to 4	−5.3 to 4.2		V
			Full range	−5 to 3.5			−5 to 3.5			
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$	25°C		4.99			4.99		V
		$I_O = -100\ \mu A$	25°C	4.85	4.94		4.85	4.94		
			Full range	4.82			4.82			
		$I_O = -400\ \mu A$	25°C	4.7	4.85		4.7	4.85		
			Full range	4.5			4.5			
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$, $I_O = 50\ \mu A$	25°C		−4.99			−4.99		V
		$V_{IC} = 0$, $I_O = 500\ \mu A$	25°C	−4.85	−4.91		−4.85	−4.91		
			Full range	−4.85			−4.85			
		$V_{IC} = 0$, $I_O = 4$ mA	25°C	−4	−4.3		−4	−4.3		
			Full range	−3.8			−3.8			
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 4$ V, $R_L = 50\ k\Omega$	25°C	80	200		80	200		V/mV
			Full range	50			50			
		$V_O = \pm 4$ V, $R_L = 1\ M\Omega$	25°C		1000			1000		
$r_{i(d)}$	Differential input resistance		25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance		25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz, P package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz, $A_V = 10$	25°C		220			220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V, $V_O = 0$, $R_S = 50\ \Omega$	25°C	75	88		75	88		dB
			Full range	75			75			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm} / \Delta V_{IO}$)	$V_{DD} = 4.4$ V to 16 V, $V_{IC} = V_{DD}/2$, No load	25°C	80	95		80	95		dB
			Full range	80			80			
I_{DD}	Supply current	$V_O = 2.5$ V, No load	25°C		425	500		425	500	µA
			Full range			500			500	

† Full range is – 40°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

TLC2262I operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm5$ V

PARAMETER		TEST CONDITIONS		T_A†	TLC2262I			TLC2262AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = \pm1.9$ V, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C	0.35	0.55		0.35	0.55		V/µs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		43			43		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.8			0.8		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	$V_O = \pm2.3$ V, $R_L = 50$ kΩ, f = 20 kHz	$A_V = 1$	25°C		0.014%			0.014%		
			$A_V = 10$			0.024%			0.024%		
	Gain-bandwidth product	f = 10 kHz, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C		0.73			0.73		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6$ V, $R_L = 50$ kΩ,	$A_V = 1$, $C_L = 100$ pF	25°C		85			85		kHz
t_s	Settling time	$A_V = -1$, Step = −2.3 V to 2.3 V, $R_L = 50$ kΩ, $C_L = 100$ pF	To 0.1%	25°C		7.1			7.1		µs
			To 0.01%			16.5			16.5		
ϕ_m	Phase margin at unity gain	$R_L = 50$ kΩ,	$C_L = 100$ pF	25°C		57°			57°		
	Gain margin			25°C		11			11		dB

† Full range is −40°C to 125°C.

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TLC2264I electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2264I MIN	TLC2264I TYP	TLC2264I MAX	TLC2264AI MIN	TLC2264AI TYP	TLC2264AI MAX	UNIT
V_{IO}	Input offset voltage	$V_{DD\pm}$ = ±2.5 V, V_O = 0,	V_{IC} = 0, R_S = 50 Ω	25°C		300	2500		300	950	μV
				Full range			3000			1500	
α_{VIO}	Temperature coefficient of input offset voltage			25°C to 125°C		2			2		μV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003			0.003		μV/mo
I_{IO}	Input offset current			25°C		0.5			0.5		pA
				Full range			500			500	
I_{IB}	Input bias current			25°C		1			1		pA
				Full range			500			500	
V_{ICR}	Common-mode input voltage range	R_S = 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
				Full range	0 to 3.5			0 to 3.5			
V_{OH}	High-level output voltage	I_{OH} = −20 μA		25°C		4.99			4.99		V
		I_{OH} = −100 μA		25°C	4.85	4.94		4.85	4.94		
				Full range	4.82			4.82			
		I_{OH} = −400 μA		25°C	4.7	4.85		4.7	4.85		
				Full range	4.5			4.5			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 μA	25°C		0.01			0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 μA	25°C		0.09	0.15		0.09	0.15	
				Full range			0.15			0.15	
		V_{IC} = 2.5 V,	I_{OL} = 4 mA	25°C		0.8	1		0.7	1	
				Full range			1.2			1.2	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ‡	25°C	80	100		80	170		V/mV
				Full range	50			50			
			R_L = 1 MΩ‡	25°C		550			550		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		240			240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, R_S = 50 Ω	V_O = 2.5 V,	25°C	70	83		70	83		dB
				Full range	70			70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V, V_{IC} = V_{DD}/2,	No load	25°C	80	95		80	95		dB
				Full range	80			80			
I_{DD}	Supply current (four amplifiers)	V_O = 2.5 V,	No load	25°C		0.8	1		0.8	1	mA
				Full range			1			1	

† Full range is – 40°C to 125°C.
‡ Referenced to 2.5 V
NOTE 4: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2264I operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLC2264I			TLC2264AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = 1.4 V to 2.6 V, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C	0.35	0.55		0.35	0.55		V/μs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		40			40		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.7			0.7		μV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, f = 20 kHz, R_L = 50 kΩ‡	A_V = 1	25°C		0.017%			0.017%		
			A_V = 10			0.03%			0.03%		
	Gain-bandwidth product	f = 50 kHz, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		0.71			0.71		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_V = 1, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		185			185		kHz
t_s	Settling time	A_V = −1, Step = 0.5 V to 2.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡	To 0.1%	25°C		6.4			6.4		μs
			To 0.01%			14.1			14.1		
ϕ_m	Phase margin at unity gain	R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		56°			56°		
	Gain margin			25°C		11			11		dB

† Full range is – 40°C to 125°C.
‡ Referenced to 2.5 V

TLC2264I electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLC2264I			TLC2264AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$, $R_S = 50\ \Omega$	25°C		300	2500		300	950	µV
			Full range			3000			1500	
α_{VIO}	Temperature coefficient of input offset voltage		25°C to 125°C		2			2		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.003			0.003		µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			500			500	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			500			500	
V_{ICR}	Common-mode input voltage range	$R_S = 50\ \Omega$, $\lvert V_{IO} \rvert \le 5$ mV	25°C	−5 to 4	−5.3 to 4.2		−5 to 4	−5.3 to 4.2		V
			Full range	−5 to 3.5			−5 to 3.5			
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$	25°C		4.99			4.99		V
		$I_O = -100\ \mu A$	25°C	4.85	4.94		4.85	4.94		
			Full range	4.82			4.82			
		$I_O = -400\ \mu A$	25°C	4.7	4.85		4.7	4.85		
			Full range	4.5			4.5			
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$, $I_O = 50\ \mu A$	25°C		−4.99			−4.99		V
		$V_{IC} = 0$, $I_O = 500\ \mu A$	25°C	−4.85	−4.91		−4.85	−4.91		
			Full range	−4.85			−4.85			
		$V_{IC} = 0$, $I_O = 4$ mA	25°C	−4	−4.3		−4	−4.3		
			Full range	−3.8			−3.8			
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 4$ V, $R_L = 50\ k\Omega$	25°C	80	200		80	200		V/mV
			Full range	50			50			
		$V_O = \pm 4$ V, $R_L = 1\ M\Omega$	25°C		1000			1000		
$r_{i(d)}$	Differential input resistance		25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance		25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz, N package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz, $A_V = 10$	25°C		220			220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V, $V_O = 0$, $R_S = 50\ \Omega$	25°C	75	88		75	88		dB
			Full range	75			75			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm 2.2$ V to ±8 V, $V_{IC} = V_{DD}/2$, No load	25°C	80	95		80	95		dB
			Full range	80			80			
I_{DD}	Supply current (four amplifiers)	$V_O = 0$, No load	25°C		0.85	1		0.85	1	mA
			Full range			1			1	

† Full range is – 40°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

TLC2264I operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V

PARAMETER		TEST CONDITIONS		T_A†	TLC2264I MIN	TLC2264I TYP	TLC2264I MAX	TLC2264AI MIN	TLC2264AI TYP	TLC2264AI MAX	UNIT
SR	Slew rate at unity gain	$V_O = \pm 1.9$ V, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C	0.35	0.55		0.35	0.55		V/µs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		43			43		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.8			0.8		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3$ V, $R_L = 50$ kΩ, f = 20 kHz	$A_V = 1$	25°C		0.014%			0.014%		
			$A_V = 10$			0.024%			0.024%		
	Gain-bandwidth product	f =10 kHz, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C		0.73			0.73		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6$ V, $R_L = 50$ kΩ,	$A_V = 1$, $C_L = 100$ pF	25°C		70			70		kHz
t_s	Settling time	$A_V = -1$, Step = −2.3 V to 2.3 V, $R_L = 50$ kΩ, $C_L = 100$ pF	To 0.1%	25°C		7.1			7.1		µs
			To 0.01%			16.5			16.5		
ϕ_m	Phase margin at unity gain	$R_L = 50$ kΩ,	$C_L = 100$ pF	25°C		57°			57°		
	Gain margin			25°C		11			11		dB

† Full range is – 40°C to 125°C.

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TLC2262M electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2262M MIN	TLC2262M TYP	TLC2262M MAX	TLC2262AM MIN	TLC2262AM TYP	TLC2262AM MAX	UNIT
V_{IO}	Input offset voltage	$V_{DD\pm}$ = ±2.5 V, V_{IC} = 0, V_O = 0, R_S = 50 Ω		25°C		300	2500		300	950	μV
				Full range			3000			1500	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		5			5		μV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003			0.003		μV/mo
I_{IO}	Input offset current			25°C		0.5			0.5		pA
				125°C			500			500	
I_{IB}	Input bias current			25°C		1			1		pA
				125°C			500			500	
V_{ICR}	Common-mode input voltage range	R_S = 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
				Full range	0 to 3.5			0 to 3.5			
V_{OH}	High-level output voltage	I_{OH} = −20 μA		25°C		4.99			4.99		V
		I_{OH} = −100 μA		25°C	4.85	4.94		4.85	4.94		
				Full range	4.82			4.82			
		I_{OH} = −400 μA		25°C	4.7	4.85		4.7	4.85		
				Full range	4.5			4.5			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 μA	25°C		0.01			0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 μA	25°C		0.09	0.15		0.09	0.15	
				Full range			0.15			0.15	
		V_{IC} = 2.5 V,	I_{OL} = 4 mA	25°C		0.8	1		0.7	1	
				Full range			1.2			1.2	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ‡	25°C	80	100		80	170		V/mV
				Full range	50			50			
			R_L = 1 MΩ‡	25°C		550			550		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	P package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		240			240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, V_O = 2.5 V, R_S = 50 Ω		25°C	70	83		70	83		dB
				Full range	70			70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V, V_{IC} = V_{DD}/2,	No load	25°C	80	95		80	95		dB
				Full range	80			80			
I_{DD}	Supply current	V_O = 2.5 V,	No load	25°C		400	500		400	500	μA
				Full range			500			500	

† Full range is – 55°C to 125°C.
‡ Referenced to 2.5 V
NOTE 4: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2262M operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLC2262M			TLC2262AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = 0.5 V to 3.5 V, C_L = 100 pF‡	R_L = 50 kΩ‡,	25°C	0.35	0.55		0.35	0.55		V/µs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		40			40		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.7			0.7		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, f = 20 kHz, R_L = 50 kΩ‡	A_V = 1	25°C		0.017%			0.017%		
			A_V = 10			0.03%			0.03%		
	Gain-bandwidth product	f = 50 kHz, C_L = 100 pF‡	R_L = 50 kΩ‡,	25°C		0.82			0.82		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, R_L = 50 kΩ‡,	A_V = 1, C_L = 100 pF‡	25°C		185			185		kHz
t_s	Settling time	A_V = –1, Step = 0.5 V to 2.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡	To 0.1%	25°C		6.4			6.4		µs
			To 0.01%			14.1			14.1		
ϕ_m	Phase margin at unity gain	R_L = 50 kΩ‡,	C_L = 100 pF‡	25°C		56°			56°		
	Gain margin			25°C		11			11		dB

† Full range is – 55°C to 125°C.
‡ Referenced to 2.5 V

TLC2262M electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm5$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2262M MIN	TLC2262M TYP	TLC2262M MAX	TLC2262AM MIN	TLC2262AM TYP	TLC2262AM MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$, $R_S = 50\ \Omega$		25°C		300	2500		300	950	µV
				Full range			3000			1500	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		5			5		µV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003			0.003		µV/mo
I_{IO}	Input offset current			25°C		0.5			0.5		pA
				125°C			500			500	
I_{IB}	Input bias current			25°C		1			1		pA
				125°C			500			500	
V_{ICR}	Common-mode input voltage range	$R_S = 50\ \Omega$, $\lvert V_{IO} \rvert \le 5$ mV		25°C	−5 to 4	−5.3 to 4.2		−5 to 4	−5.3 to 4.2		V
				Full range	−5 to 3.5			−5 to 3.5			
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$		25°C		4.99			4.99		V
		$I_O = -100\ \mu A$		25°C	4.85	4.94		4.85	4.94		
				Full range	4.82			4.82			
		$I_O = -400\ \mu A$		25°C	4.7	4.85		4.7	4.85		
				Full range	4.5			4.5			
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$, $I_O = 50\ \mu A$		25°C		−4.99			−4.99		V
		$V_{IC} = 0$, $I_O = 500\ \mu A$		25°C	−4.85	−4.91		−4.85	−4.91		
				Full range	−4.85			−4.85			
		$V_{IC} = 0$, $I_O = 4$ mA		25°C	−4	−4.3		−4	−4.3		
				Full range	−3.8			−3.8			
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm4$ V	$R_L = 50\ k\Omega$	25°C	80	200		80	200		V/mV
				Full range	50			50			
			$R_L = 1\ M\Omega$	25°C		1000			1000		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz, P package		25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz, $A_V = 10$		25°C		220			220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V, $V_O = 0$, $R_S = 50\ \Omega$		25°C	75	88		75	88		dB
				Full range	75			75			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD} = 4.4$ V to 16 V, $V_{IC} = V_{DD}/2$, No load		25°C	80	95		80	95		dB
				Full range	80			80			
I_{DD}	Supply current	$V_O = 0$, No load		25°C		425	500		425	500	µA
				Full range			500			500	

† Full range is – 55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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.

TLC2262M operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm5$ V

PARAMETER		TEST CONDITIONS		T_A†	TLC2262M			TLC2262AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = \pm2$ V, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C	0.35	0.55		0.35	0.55		V/µs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		43			43		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.8			0.8		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA√Hz
THD + N	Total harmonic distortion plus noise	$V_O = \pm2.3$ V, $R_L = 50$ kΩ, f = 20 kHz	$A_V = 1$	25°C		0.014%			0.014%		
			$A_V = 10$			0.024%			0.024%		
	Gain-bandwidth product	f =10 kHz, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C		0.73			0.73		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6$ V, $R_L = 50$ kΩ,	$A_V = 1$, $C_L = 100$ pF	25°C		85			85		kHz
t_s	Settling time	$A_V = -1$, Step = −2.3 V to 2.3 V, $R_L = 50$ kΩ, $C_L = 100$ pF	To 0.1%	25°C		7.1			7.1		µs
			To 0.01%			16.5			16.5		
ϕ_m	Phase margin at unity gain	$R_L = 50$ kΩ,	$C_L = 100$ pF	25°C		57°			57°		
	Gain margin			25°C		11			11		dB

† Full range is −55°C to 125°C.

TLC2264M electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLC2264M			TLC2264AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	$V_{DD\pm}$ = ±2.5 V, V_O = 0,	V_{IC} = 0, R_S = 50 Ω	25°C		300	2500		300	950	µV
				Full range			3000			1500	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		2			2		µV/°C
	Input offset voltage long-term drift (see Note 4)			25°C		0.003			0.003		µV/mo
I_{IO}	Input offset current			25°C		0.5			0.5		pA
				125°C			500			500	
I_{IB}	Input bias current			25°C		1			1		pA
				125°C			500			500	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω,	$\|V_{IO}\| \le 5$ mV	25°C	0 to 4	−0.3 to 4.2		0 to 4	−0.3 to 4.2		V
				Full range	0 to 3.5			0 to 3.5			
V_{OH}	High-level output voltage	I_{OH} = −20 µA		25°C		4.99			4.99		V
		I_{OH} = −100 µA		25°C	4.85	4.94		4.85	4.94		
				Full range	4.82			4.82			
		I_{OH} = −400 µA		25°C	4.7	4.85		4.7	4.85		
				Full range	4.5			4.5			
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 µA	25°C		0.01			0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 µA	25°C		0.09	0.15		0.09	0.15	
				Full range			0.15			0.15	
		V_{IC} = 2.5 V,	I_{OL} = 4 mA	25°C		0.8	1		0.7	1	
				Full range			1.2			1.2	
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ‡	25°C	80	100		80	170		V/mV
				Full range	50			50			
			R_L = 1 MΩ‡	25°C		550			550		
$r_{i(d)}$	Differential input resistance			25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance			25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz,	N package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10	25°C		240			240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V, R_S = 50 Ω	V_O = 2.5 V,	25°C	70	83		70	83		dB
				Full range	70			70			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V, $V_{IC} = V_{DD}/2$,	No load	25°C	80	95		80	95		dB
				Full range	80			80			
I_{DD}	Supply current (four amplifiers)	V_O = 2.5 V,	No load	25°C		0.8	1		0.8	1	mA
				Full range			1			1	

† Full range is – 55°C to 125°C.
‡ Referenced to 2.5 V
NOTE 4: Typical values are based on the input offset voltage shift observed through 500 hours of operating life test at T_A = 150°C extrapolated to T_A = 25°C using the Arrhenius equation and assuming an activation energy of 0.96 eV.

TLC2264M operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS		T_A†	TLC2264M MIN	TLC2264M TYP	TLC2264M MAX	TLC2264AM MIN	TLC2264AM TYP	TLC2264AM MAX	UNIT
SR	Slew rate at unity gain	V_O = 0.5 V to 3.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C	0.35	0.55		0.35	0.55		V/μs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		40			40		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.7			0.7		μV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	V_O = 0.5 V to 2.5 V, f = 20 kHz, R_L = 50 kΩ‡	A_V = 1	25°C		0.017%			0.017%		
			A_V = 10			0.03%			0.03%		
	Gain-bandwidth product	f = 50 kHz, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		0.71			0.71		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_V = 1, R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		185			185		kHz
t_s	Settling time	A_V = −1, Step = 0.5 V to 2.5 V, R_L = 50 kΩ‡, C_L = 100 pF‡	To 0.1%	25°C		6.4			6.4		μs
			To 0.01%			14.1			14.1		
ϕ_m	Phase margin at unity gain	R_L = 50 kΩ‡, C_L = 100 pF‡		25°C		56°			56°		
	Gain margin			25°C		11			11		dB

† Full range is – 55°C to 125°C.
‡ Referenced to 2.5 V

TLC2264M electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm5$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLC2264M MIN	TLC2264M TYP	TLC2264M MAX	TLC2264AM MIN	TLC2264AM TYP	TLC2264AM MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$, $R_S = 50\ \Omega$	25°C		300	2500		300	950	µV
			Full range			3000			1500	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		2			2		µV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.003			0.003		µV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			125°C			500			500	
I_{IB}	Input bias current		25°C		1			1		pA
			125°C			500			500	
V_{ICR}	Common-mode input voltage range	$R_S = 50\ \Omega$, $\lvert V_{IO} \rvert \le 5$ mV	25°C	−5 to 4	−5.3 to 4.2		−5 to 4	−5.3 to 4.2		V
			Full range	−5 to 3.5			−5 to 3.5			
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$	25°C		4.99			4.99		V
		$I_O = -100\ \mu A$	25°C	4.85	4.94		4.85	4.94		
			Full range	4.82			4.82			
		$I_O = -400\ \mu A$	25°C	4.7	4.85		4.7	4.85		
			Full range	4.5			4.5			
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$, $I_O = 50\ \mu A$	25°C		−4.99			−4.99		V
		$V_{IC} = 0$, $I_O = 500\ \mu A$	25°C	−4.85	−4.91		−4.85	−4.91		
			Full range	−4.85			−4.85			
		$V_{IC} = 0$, $I_O = 4$ mA	25°C	−4	−4.3		−4	−4.3		
			Full range	−3.8			−3.8			
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm4$ V, $R_L = 50\ k\Omega$	25°C	80	200		80	200		V/mV
			Full range	50			50			
		$V_O = \pm4$ V, $R_L = 1\ M\Omega$	25°C		1000			1000		
$r_{i(d)}$	Differential input resistance		25°C		10^{12}			10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance		25°C		10^{12}			10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz, N package	25°C		8			8		pF
z_o	Closed-loop output impedance	f = 100 kHz, $A_V = 10$	25°C		220			220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V, $V_O = 0$, $R_S = 50\ \Omega$	25°C	75	88		75	88		dB
			Full range	75			75			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm2.2$ V to ±8 V, $V_{IC} = V_{DD}/2$, No load	25°C	80	95		80	95		dB
			Full range	80			80			
I_{DD}	Supply current (four amplifiers)	$V_O = 0$, No load	25°C		0.85	1		0.85	1	mA
			Full range			1			1	

† Full range is – 55°C to 125°C.

NOTE 4: Typical values are based on the input offset voltage shift observed through 500 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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TLC2264M operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V

PARAMETER		TEST CONDITIONS		T_A†	TLC2264M MIN	TLC2264M TYP	TLC2264M MAX	TLC2264AM MIN	TLC2264AM TYP	TLC2264AM MAX	UNIT
SR	Slew rate at unity gain	$V_O = \pm 2$ V, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C	0.35	0.55		0.35	0.55		V/µs
				Full range	0.25			0.25			
V_n	Equivalent input noise voltage	f = 10 Hz		25°C		43			43		nV/√Hz
		f = 1 kHz		25°C		12			12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz		25°C		0.8			0.8		µV
		f = 0.1 Hz to 10 Hz		25°C		1.3			1.3		
I_n	Equivalent input noise current			25°C		0.6			0.6		fA/√Hz
THD + N	Total harmonic distortion plus noise	$V_O = \pm 2.3$ V, $R_L = 50$ kΩ, f = 20 kHz	$A_V = 1$	25°C		0.014%			0.014%		
			$A_V = 10$			0.024%			0.024%		
	Gain-bandwidth product	f =10 kHz, $C_L = 100$ pF	$R_L = 50$ kΩ,	25°C		0.73			0.73		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 4.6$ V, $R_L = 50$ kΩ,	$A_V = 1$, $C_L = 100$ pF	25°C		70			70		kHz
t_s	Settling time	$A_V = -1$, Step = –2.3 V to 2.3 V, $R_L = 50$ kΩ, $C_L = 100$ pF	To 0.1%	25°C		7.1			7.1		µs
			To 0.01%			16.5			16.5		
ϕ_m	Phase margin at unity gain	$R_L = 50$ kΩ,	$C_L = 100$ pF	25°C		57°			57°		
	Gain margin			25°C		11			11		dB

† Full range is –55°C to 125°C.

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TLC2262Y electrical characteristics at V_{DD} = 5 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS			TLC2262Y MIN	TLC2262Y TYP	TLC2262Y MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω			300		µV
I_{IO}	Input offset current	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω			0.5		pA
I_{IB}	Input bias current	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω			1		pA
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\| \leq 5$ mV,	R_S = 50 Ω			−0.3 to 4.2		V
V_{OH}	High-level output voltage	I_{OH} = −20 µA				4.99		V
		I_{OH} = −100 µA				4.94		
		I_{OH} = −400 µA				4.85		
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 µA			0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 µA			0.09		
		V_{IC} = 2.5 V,	I_{OL} = 4 mA			0.8		
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ†			170		V/mV
			R_L = 1 MΩ†			550		
$r_{i(d)}$	Differential input resistance					10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance					10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz				8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10			240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V,	V_O = 2.5 V,	R_S = 50 Ω		83		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V,	$V_{IC} = V_{DD}/2$,	No load		95		dB
I_{DD}	Supply current	V_O = 2.5 V,	No load			400		µA

† Referenced to 2.5 V

TLC2262Y electrical characteristics at $V_{DD\pm} = \pm 5$ V, $T_A = 25°C$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		TLC2262Y MIN	TLC2262Y TYP	TLC2262Y MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$	$R_S = 50\ \Omega$,		300		µV
I_{IO}	Input offset current	$V_{IC} = 0$, $V_O = 0$	$R_S = 50\ \Omega$,		0.5		pA
I_{IB}	Input bias current	$V_{IC} = 0$, $V_O = 0$	$R_S = 50\ \Omega$,		1		pA
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\| \le 5$ mV,	$R_S = 50\ \Omega$		−5.3 to 4.2		V
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$			4.99		V
		$I_O = -100\ \mu A$			4.94		
		$I_O = -400\ \mu A$			4.85		
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$,	$I_{OL} = 50\ \mu A$		−4.99		V
		$V_{IC} = 0$,	$I_{OL} = 500\ \mu A$		−4.91		
		$V_{IC} = 0$,	$I_{OL} = 4$ mA		−4.1		
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 4$ V	$R_L = 50\ k\Omega$		200		V/mV
			$R_L = 1\ M\Omega$		1000		
$r_{i(d)}$	Differential input resistance				10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance				10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz			8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	$A_V = 10$		220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V,	$V_O = 0$, $R_S = 50\ \Omega$		88		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm 2.2$ V to ± 8 V,	$V_{IC} = 0$, No load		95		dB
I_{DD}	Supply current	$V_O = 0$,	No load		425		µA

TLC2264Y electrical characteristics at V_{DD} = 5 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS			TLC2264Y MIN	TLC2264Y TYP	TLC2264Y MAX	UNIT
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω			300		μV
I_{IO}	Input offset current	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω			0.5		pA
I_{IB}	Input bias current	V_{IC} = 0, V_O = 0,	$V_{DD\pm}$ = ±2.5 V, R_S = 50 Ω			1		pA
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\| \le 5$ mV,	R_S = 50 Ω			−0.3 to 4.2		V
V_{OH}	High-level output voltage	I_{OH} = −20 μA				4.99		V
		I_{OH} = −100 μA				4.94		
		I_{OH} = −400 μA				4.85		
V_{OL}	Low-level output voltage	V_{IC} = 2.5 V,	I_{OL} = 50 μA			0.01		V
		V_{IC} = 2.5 V,	I_{OL} = 500 μA			0.09		
		V_{IC} = 2.5 V,	I_{OL} = 4 mA			0.8		
A_{VD}	Large-signal differential voltage amplification	V_{IC} = 2.5 V, V_O = 1 V to 4 V	R_L = 50 kΩ†			170		V/mV
			R_L = 1 MΩ†			550		
$r_{i(d)}$	Differential input resistance					10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance					10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz				8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	A_V = 10			240		Ω
CMRR	Common-mode rejection ratio	V_{IC} = 0 to 2.7 V,	V_O = 2.5 V,	R_S = 50 Ω		83		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	V_{DD} = 4.4 V to 16 V,	$V_{IC} = V_{DD}/2$,	No load		95		dB
I_{DD}	Supply current (four amplifiers)	V_O = 2.5 V,	No load			0.8		mA

† Referenced to 2.5 V

TLC2264Y electrical characteristics at $V_{DD\pm} = \pm 5$ V, $T_A = 25°C$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS			TLC2264Y MIN	TLC2264Y TYP	TLC2264Y MAX	UNIT
V_{IO}	Input offset voltage	$V_{IC} = 0$, $V_O = 0$	$R_S = 50\ \Omega$,			300		µV
I_{IO}	Input offset current	$V_{IC} = 0$, $V_O = 0$	$R_S = 50\ \Omega$,			0.5		pA
I_{IB}	Input bias current	$V_{IC} = 0$, $V_O = 0$	$R_S = 50\ \Omega$,			1		pA
V_{ICR}	Common-mode input voltage range	$\|V_{IO}\| \le 5$ mV,	$R_S = 50\ \Omega$			−5.3 to 4.2		V
V_{OM+}	Maximum positive peak output voltage	$I_O = -20\ \mu A$				4.99		V
		$I_O = -100\ \mu A$				4.94		
		$I_O = -400\ \mu A$				4.85		
V_{OM-}	Maximum negative peak output voltage	$V_{IC} = 0$,	$I_{OL} = 50\ \mu A$			−4.99		V
		$V_{IC} = 0$,	$I_{OL} = 500\ \mu A$			−4.91		
		$V_{IC} = 0$,	$I_{OL} = 4$ mA			−4.1		
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 4$ V	$R_L = 50\ k\Omega$			200		V/mV
			$R_L = 1\ M\Omega$			1000		
$r_{i(d)}$	Differential input resistance					10^{12}		Ω
$r_{i(c)}$	Common-mode input resistance					10^{12}		Ω
$c_{i(c)}$	Common-mode input capacitance	f = 10 kHz				8		pF
z_o	Closed-loop output impedance	f = 100 kHz,	$A_V = 10$			220		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = -5$ V to 2.7 V,	$V_O = 0$,	$R_S = 50\ \Omega$		88		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	$V_{DD\pm} = \pm 2.2$ V to ± 8 V,	$V_{IC} = 0$,	No load		95		dB
I_{DD}	Supply current (four amplifiers)	$V_O = 0$,	No load			0.85		mA

TYPICAL CHARACTERISTICS

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TYPICAL CHARACTERISTICS

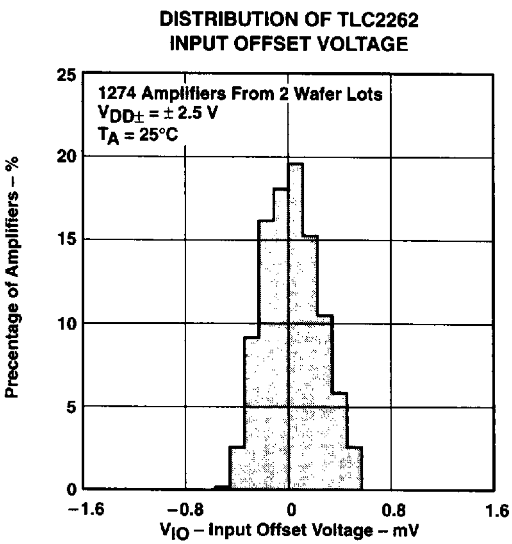


Figure 2

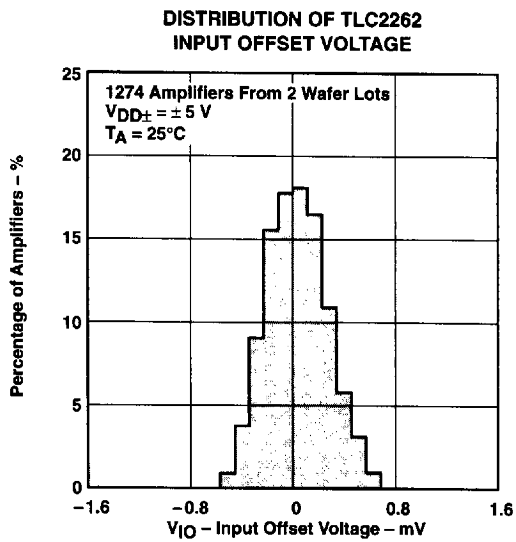


Figure 3

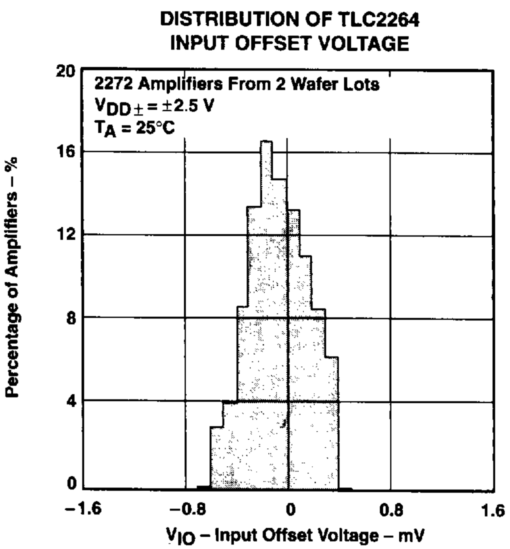


Figure 4

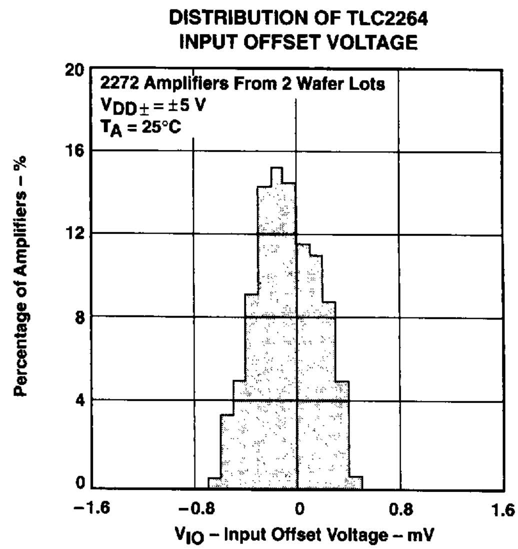
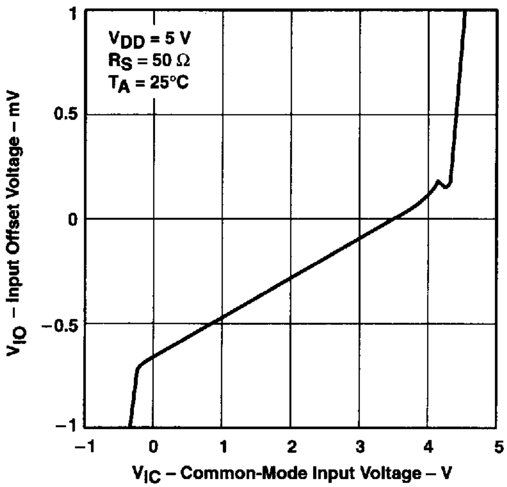


Figure 5

TYPICAL CHARACTERISTICS

INPUT OFFSET VOLTAGE
vs
COMMON-MODE INPUT VOLTAGE



† For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

Figure 6

INPUT OFFSET VOLTAGE
vs
COMMON-MODE INPUT VOLTAGE

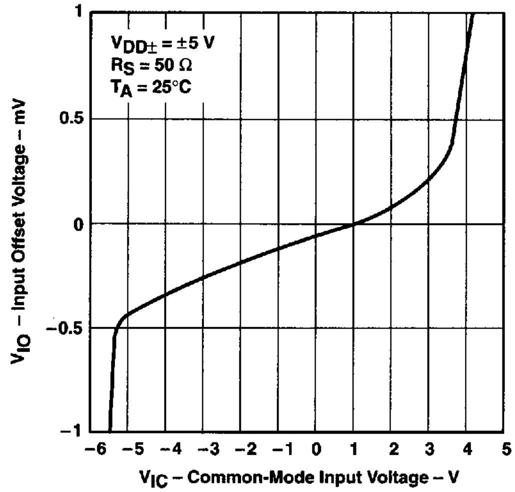


Figure 7

DISTRIBUTION OF TLC2262 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT†

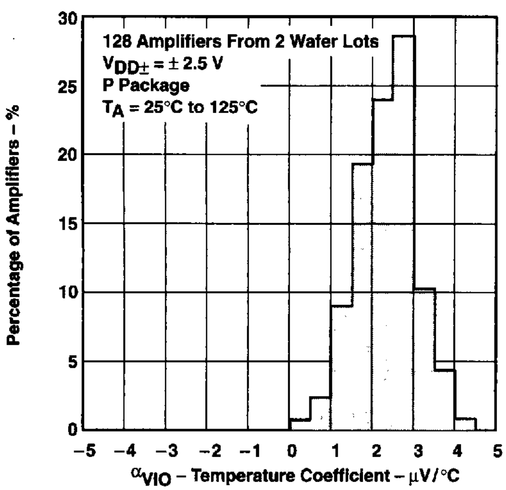


Figure 8

DISTRIBUTION OF TLC2262 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT†

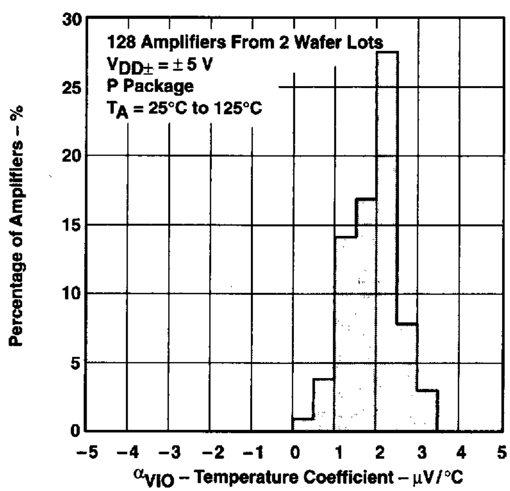


Figure 9

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

TYPICAL CHARACTERISTICS

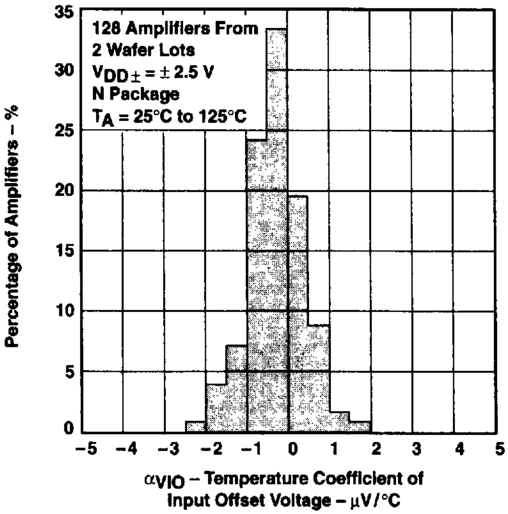


Figure 10

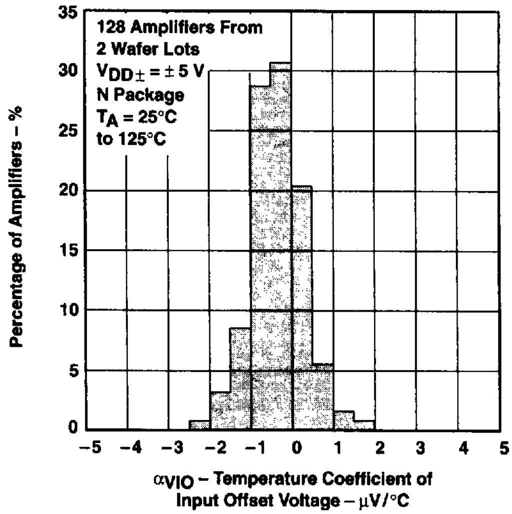


Figure 11

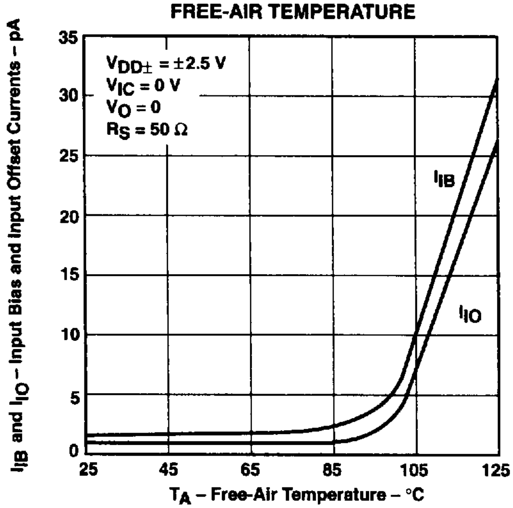


Figure 12

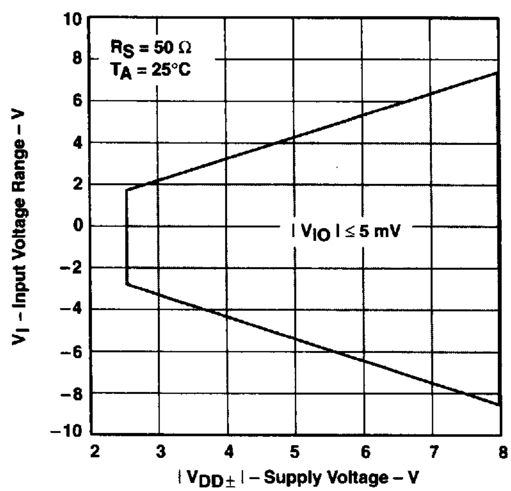


Figure 13

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

TYPICAL CHARACTERISTICS

INPUT VOLTAGE RANGE†‡
vs
FREE-AIR TEMPERATURE

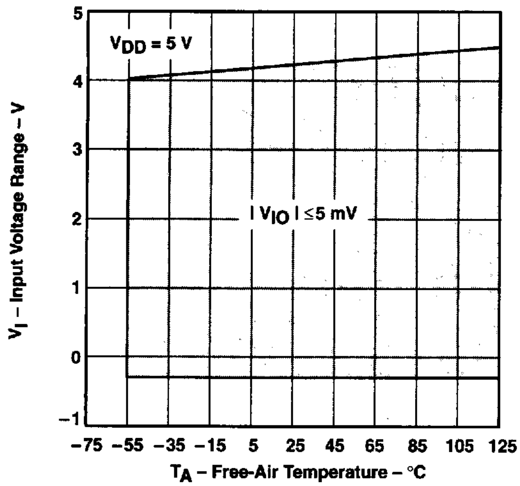


Figure 14

HIGH-LEVEL OUTPUT VOLTAGE†‡
vs
HIGH-LEVEL OUTPUT CURRENT

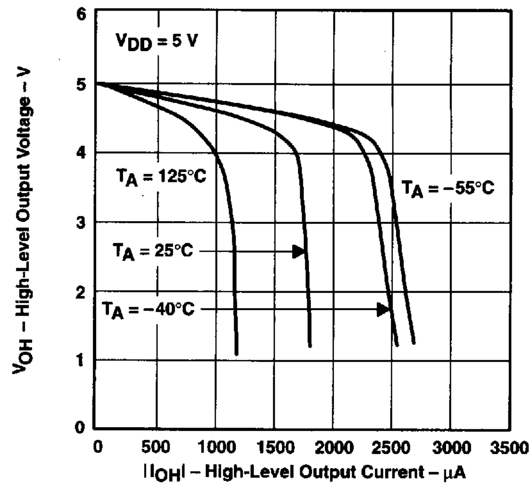


Figure 15

LOW-LEVEL OUTPUT VOLTAGE‡
vs
LOW-LEVEL OUTPUT CURRENT

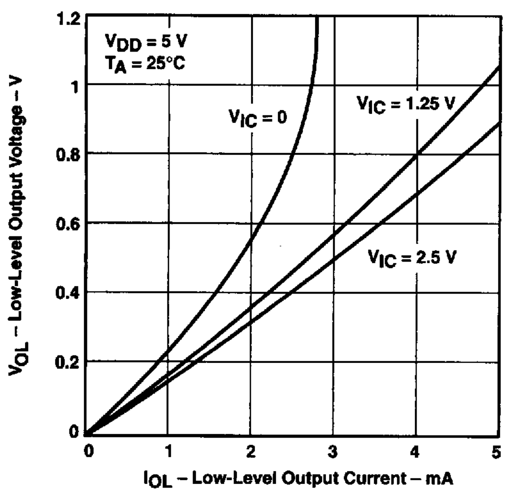


Figure 16

LOW-LEVEL OUTPUT VOLTAGE†‡
vs
LOW-LEVEL OUTPUT CURRENT

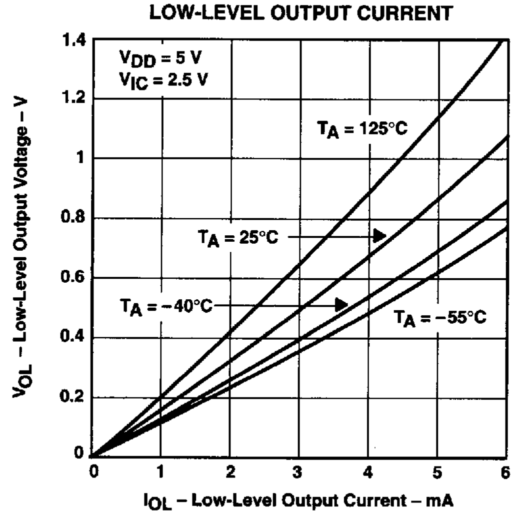


Figure 17

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.
‡ For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

MAXIMUM POSITIVE OUTPUT VOLTAGE†
vs
OUTPUT CURRENT

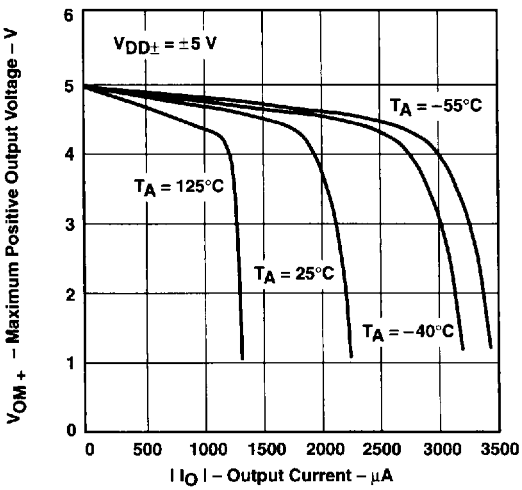


Figure 18

MAXIMUM NEGATIVE OUTPUT VOLTAGE†
vs
OUTPUT CURRENT

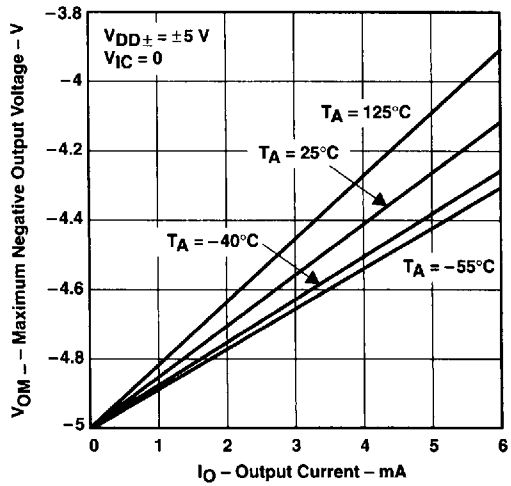
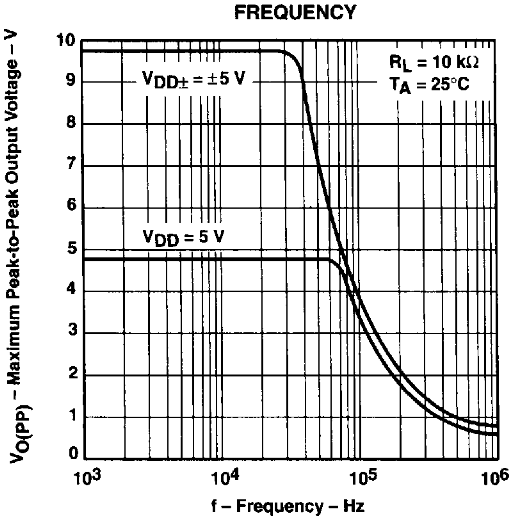


Figure 19

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE†‡
vs
FREQUENCY



‡ For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

Figure 20

SHORT-CIRCUIT OUTPUT CURRENT
vs
SUPPLY VOLTAGE

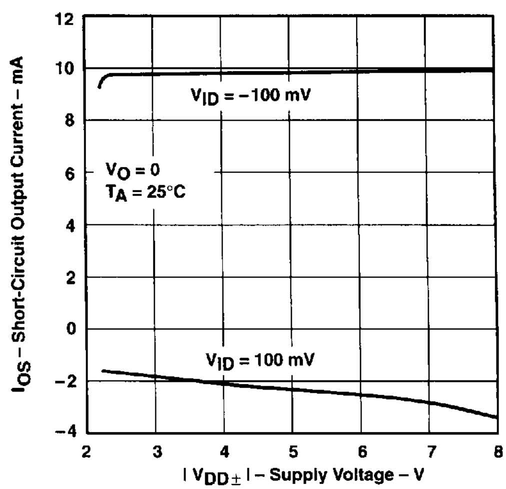


Figure 21

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

TYPICAL CHARACTERISTICS

SHORT-CIRCUIT OUTPUT CURRENT†
vs
FREE-AIR TEMPERATURE

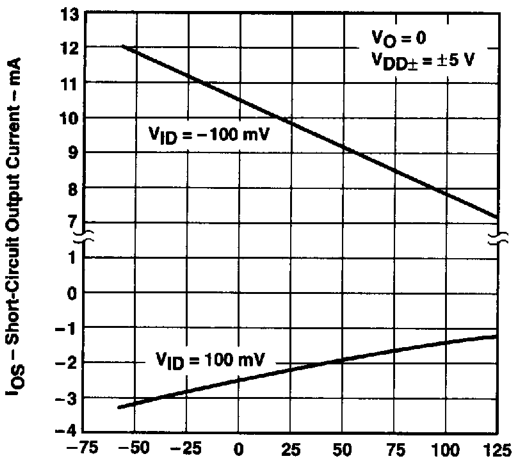


Figure 22

OUTPUT VOLTAGE‡
vs
DIFFERENTIAL INPUT VOLTAGE

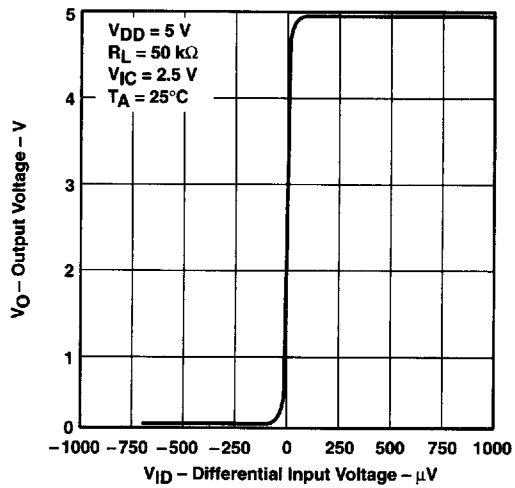


Figure 23

OUTPUT VOLTAGE
vs
DIFFERENTIAL INPUT VOLTAGE

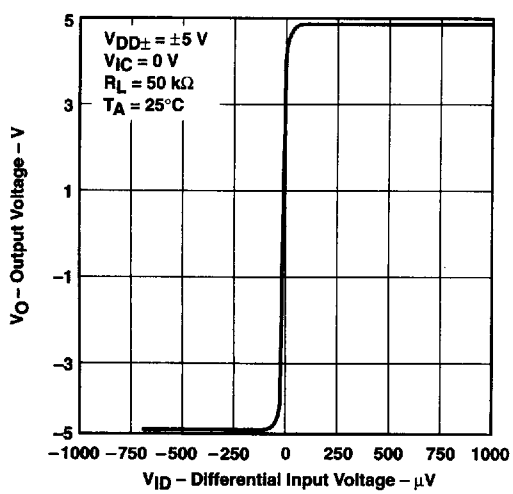


Figure 24

DIFFERENTIAL GAIN‡
vs
LOAD RESISTANCE

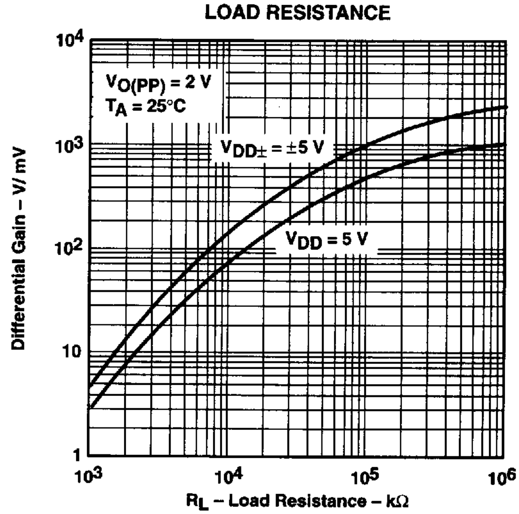
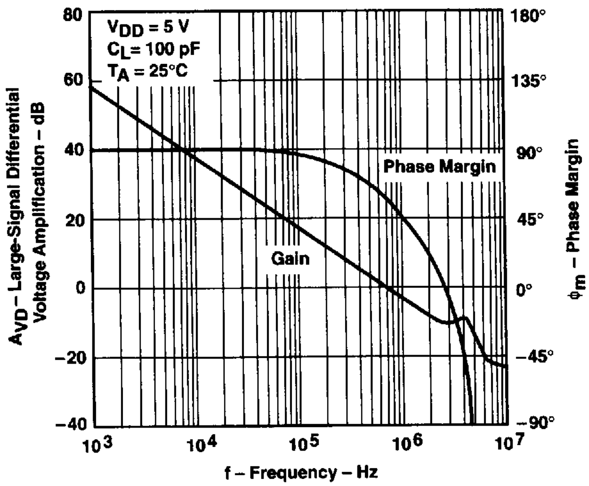


Figure 25

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.
‡ For curves where $V_{DD} = 5$ V, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE† AMPLIFICATION AND PHASE MARGIN vs FREQUENCY



† For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

Figure 26

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN vs FREQUENCY

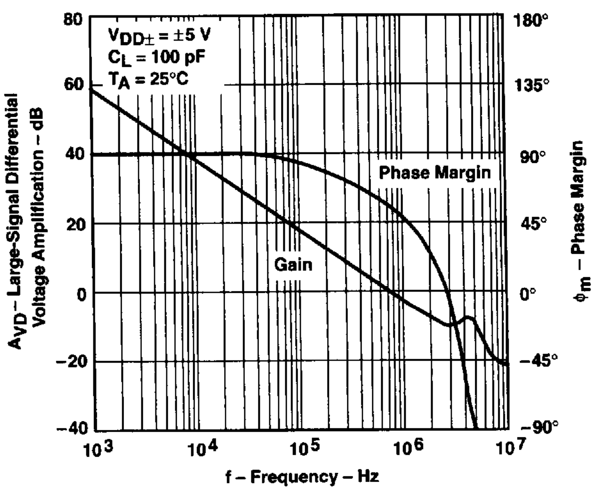


Figure 27

TYPICAL CHARACTERISTICS

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

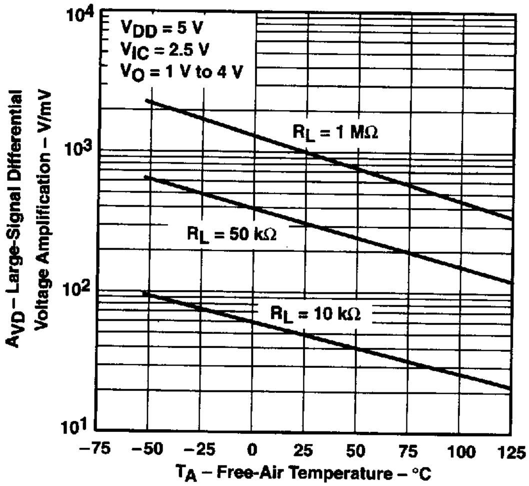


Figure 28

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

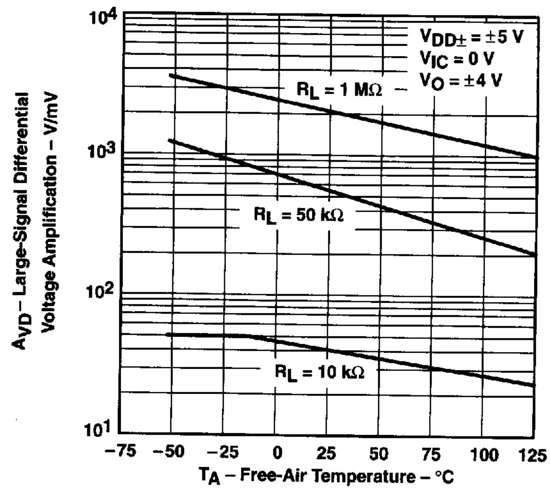


Figure 29

OUTPUT IMPEDANCE‡ vs FREQUENCY

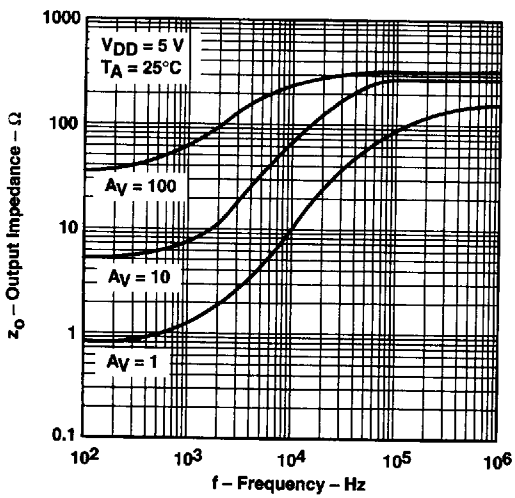


Figure 30

OUTPUT IMPEDANCE vs FREQUENCY

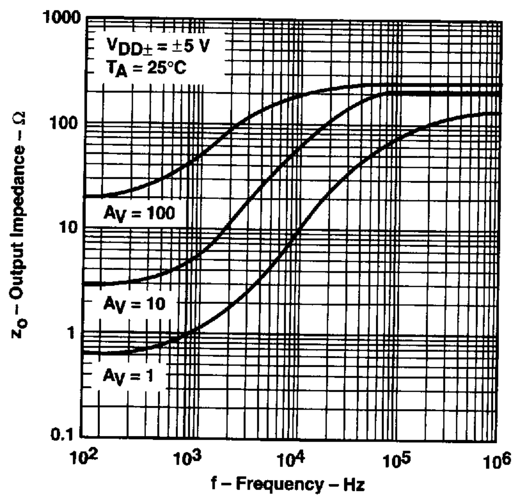


Figure 31

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.
‡ For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

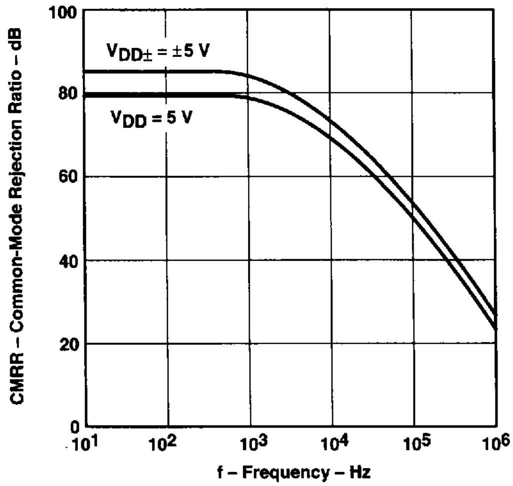


Figure 32

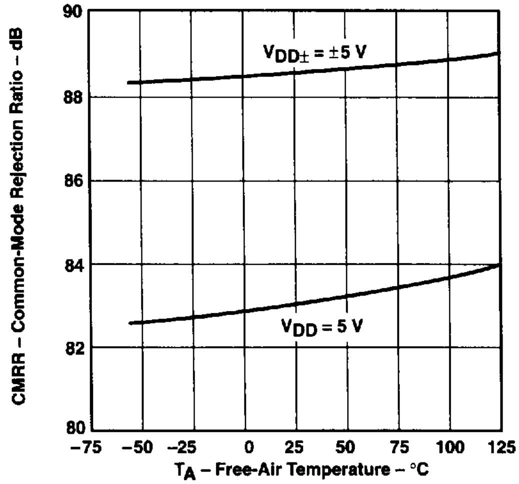


Figure 33

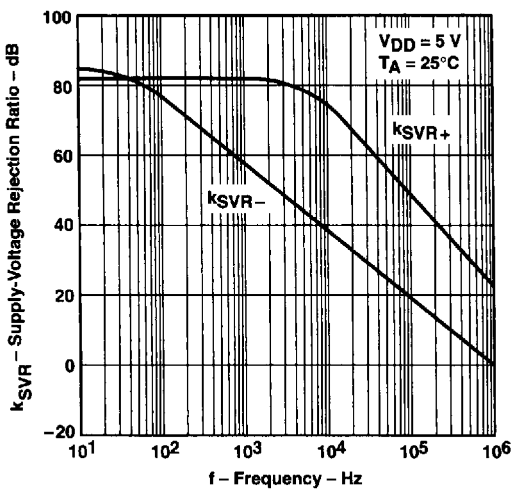


Figure 34

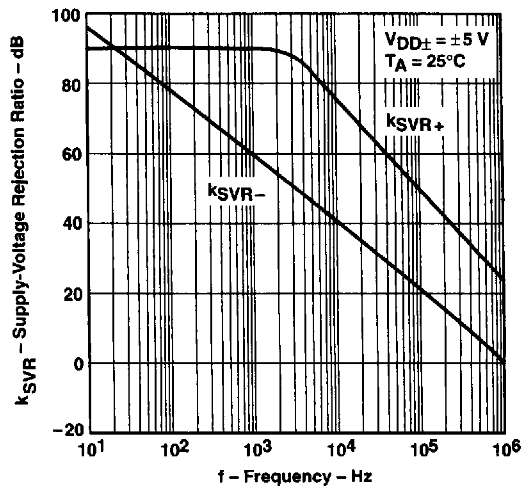


Figure 35

† For curves where $V_{DD} = 5$ V, all loads are referenced to 2.5 V.
‡ Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS

SUPPLY-VOLTAGE REJECTION RATIO†
vs
FREE-AIR TEMPERATURE

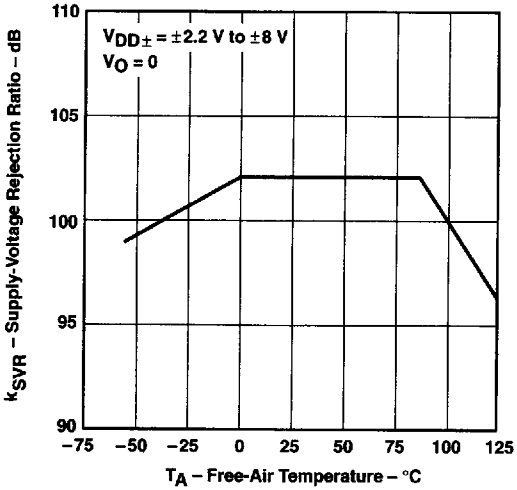


Figure 36

TLC2262
SUPPLY CURRENT†
vs
SUPPLY VOLTAGE

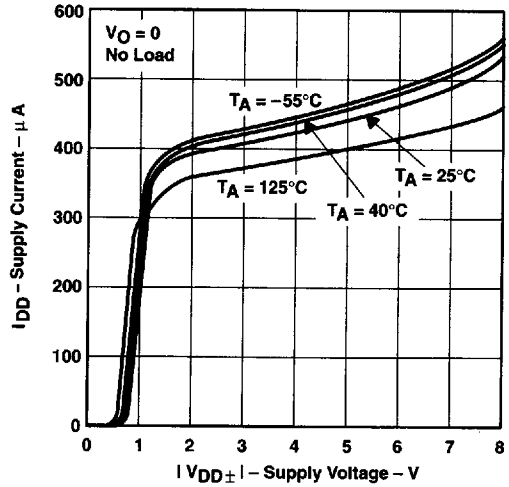


Figure 37

TLC2264
SUPPLY CURRENT†
vs
SUPPLY VOLTAGE

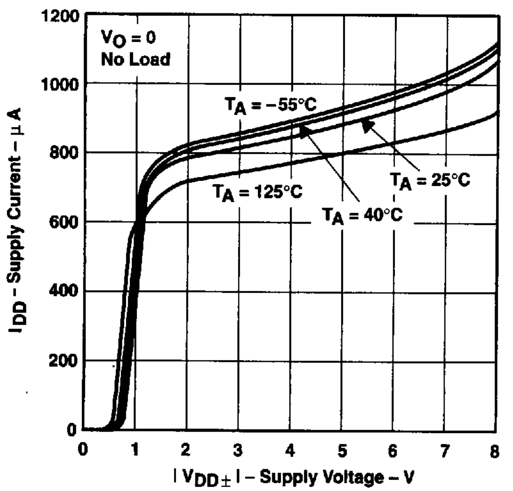


Figure 38

TLC2262
SUPPLY CURRENT†‡
vs
FREE-AIR TEMPERATURE

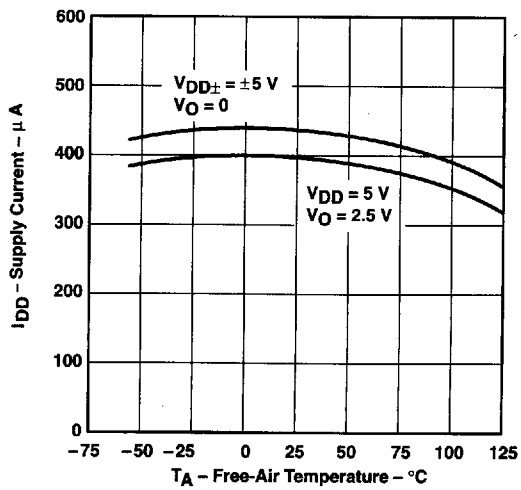


Figure 39

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.
‡ For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

8961724 0106910 136

TYPICAL CHARACTERISTICS

TLC2264
SUPPLY CURRENT†‡
vs
FREE-AIR TEMPERATURE

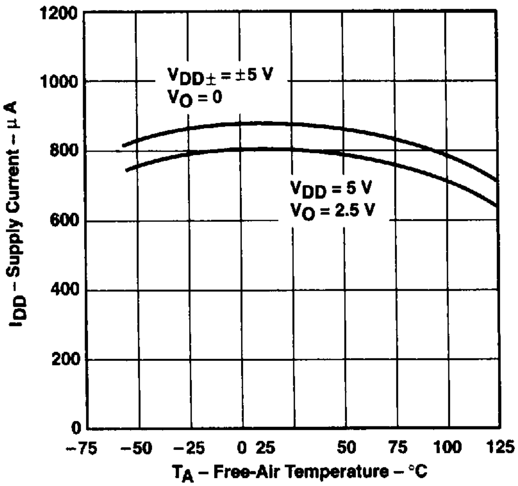


Figure 40

SLEW RATE‡
vs
LOAD CAPACITANCE

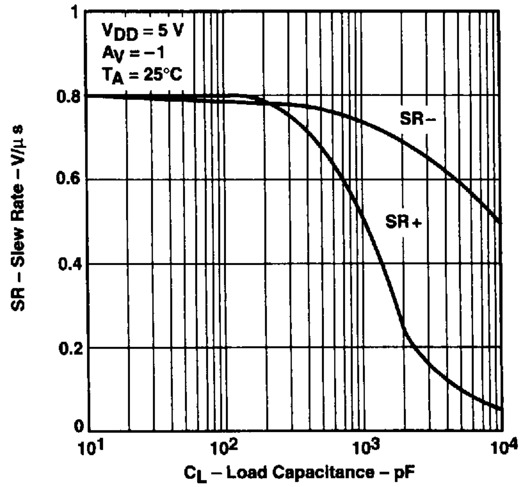


Figure 41

SLEW RATE†‡
vs
FREE-AIR TEMPERATURE

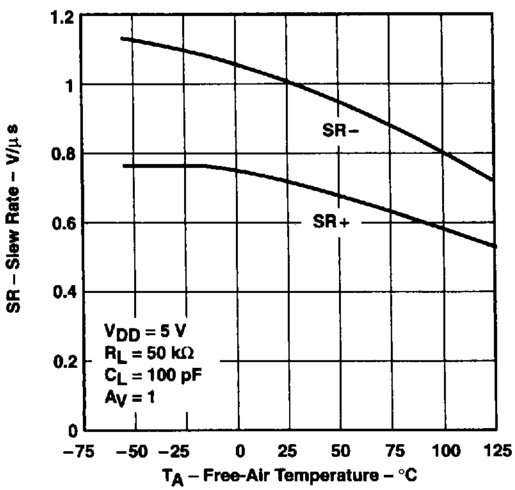


Figure 42

INVERTING LARGE-SIGNAL PULSE RESPONSE‡

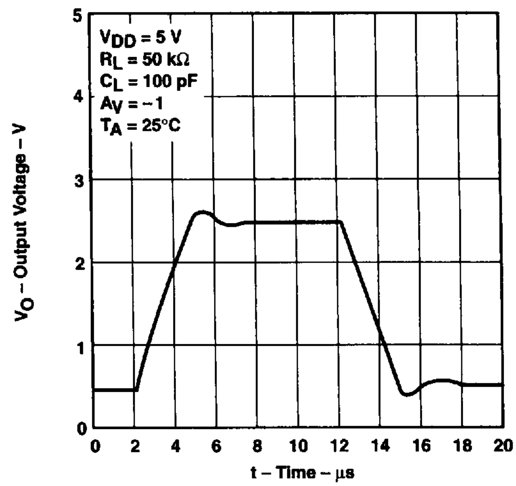


Figure 43

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.
‡ For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

INVERTING LARGE-SIGNAL PULSE RESPONSE

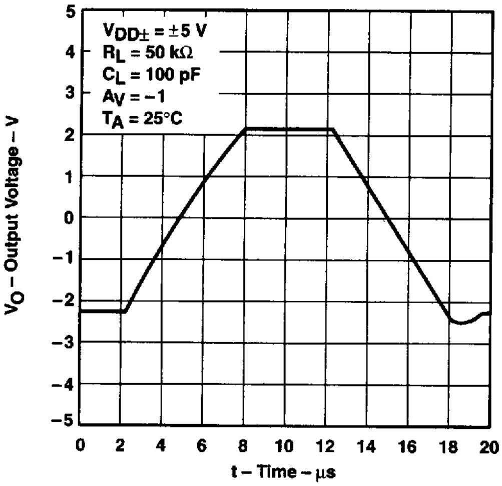


Figure 44

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE†

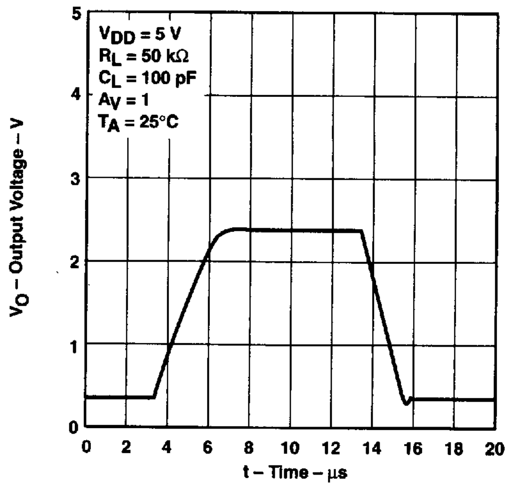


Figure 45

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

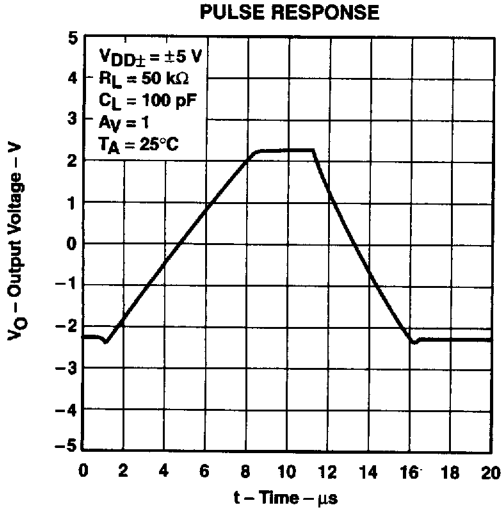


Figure 46

INVERTING SMALL-SIGNAL PULSE RESPONSE†

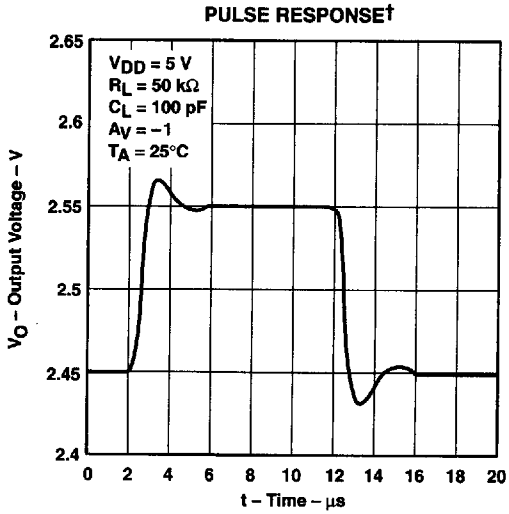


Figure 47

† For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

8961724 0106912 T09

TYPICAL CHARACTERISTICS

INVERTING SMALL-SIGNAL PULSE RESPONSE

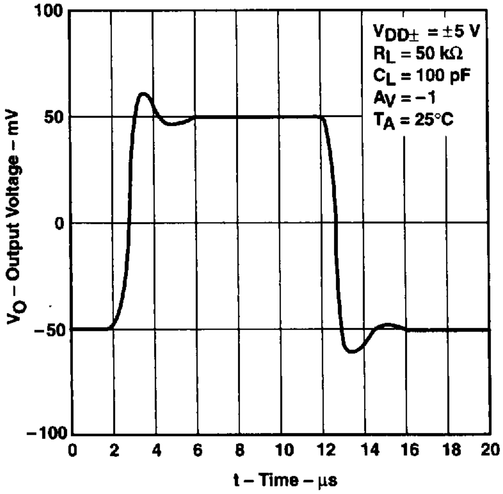


Figure 48

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE†

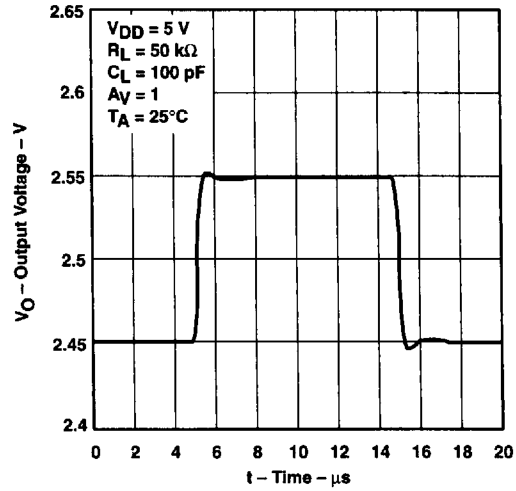


Figure 49

VOLTAGE-FOLLOWER SMALL-SIGNAL PULSE RESPONSE

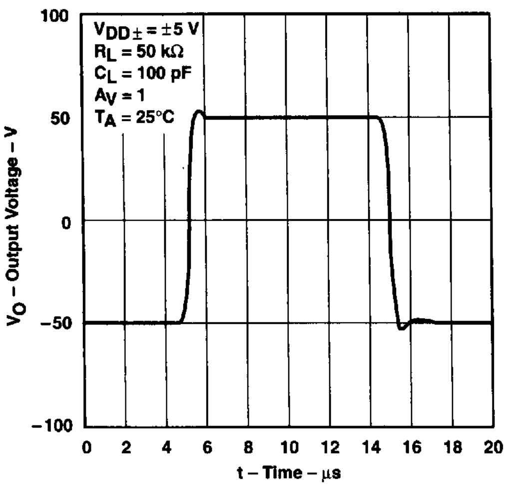


Figure 50

EQUIVALENT INPUT NOISE VOLTAGE† vs FREQUENCY

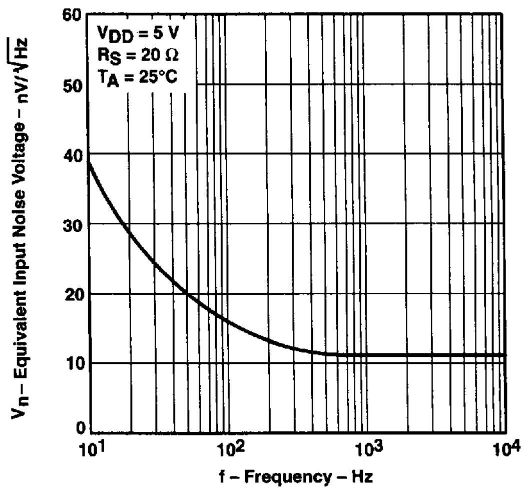


Figure 51

† For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

8961724 0106913 945

TYPICAL CHARACTERISTICS

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

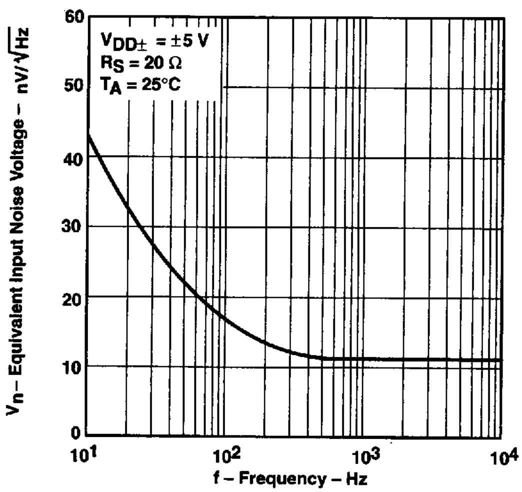


Figure 52

EQUIVALENT INPUT NOISE VOLTAGE OVER A 10-SECOND PERIOD†

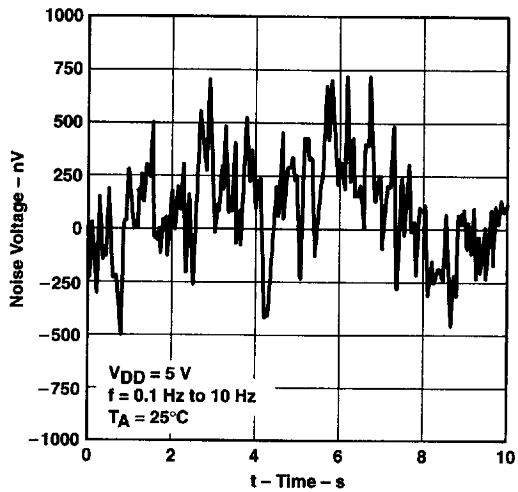


Figure 53

INTEGRATED NOISE VOLTAGE vs FREQUENCY

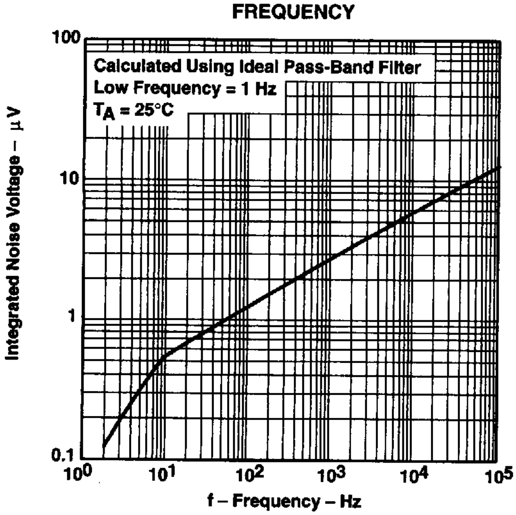


Figure 54

TOTAL HARMONIC DISTORTION PLUS NOISE† vs FREQUENCY

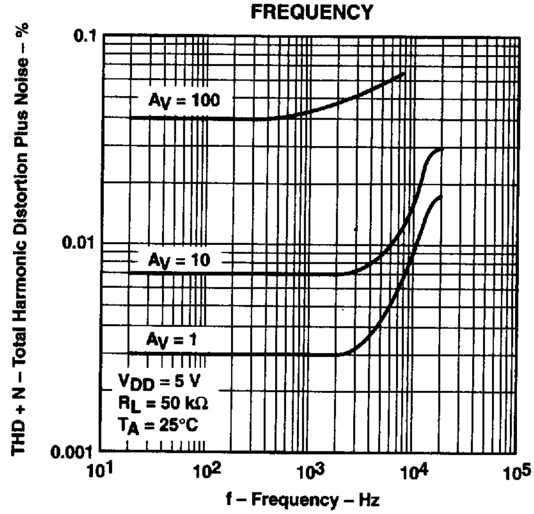


Figure 55

† For curves where $V_{DD} = 5$ V, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

GAIN-BANDWIDTH PRODUCT
vs
SUPPLY VOLTAGE

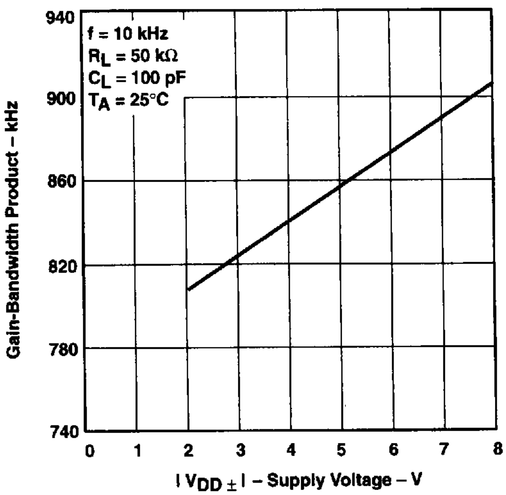


Figure 56

GAIN-BANDWIDTH PRODUCT†‡
vs
FREE-AIR TEMPERATURE

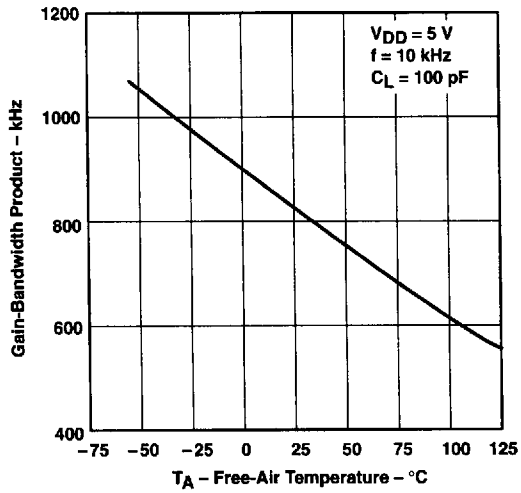


Figure 57

PHASE MARGIN
vs
LOAD CAPACITANCE

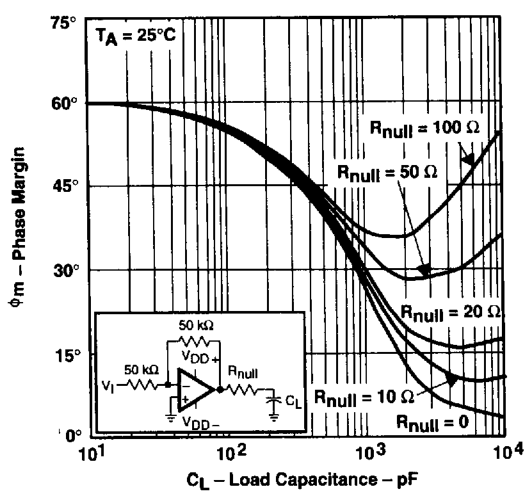


Figure 58

GAIN MARGIN
vs
LOAD CAPACITANCE

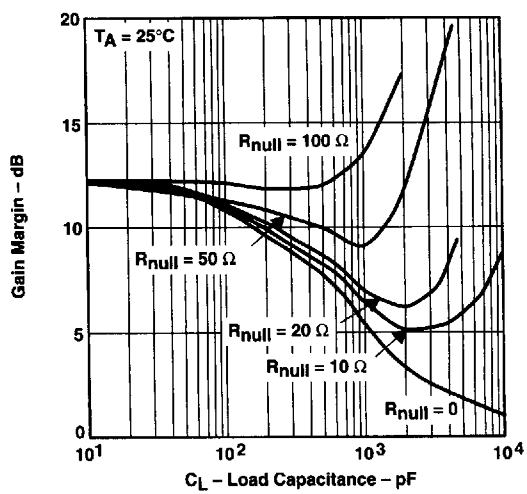


Figure 59

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.
‡ For curves where V_{DD} = 5 V, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

UNITY-GAIN BANDWIDTH†
vs
LOAD CAPACITANCE

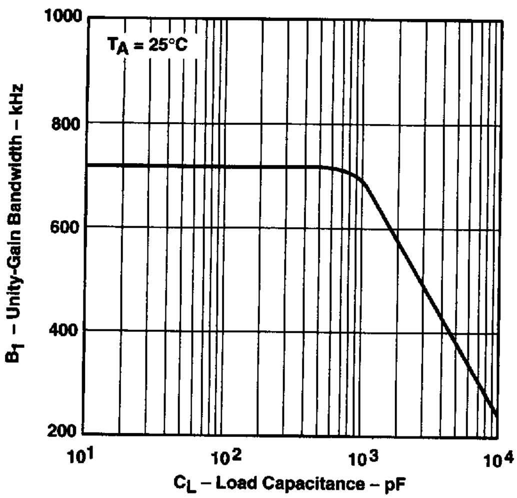


Figure 60

OVERESTIMATION OF PHASE MARGIN†
vs
LOAD CAPACITANCE

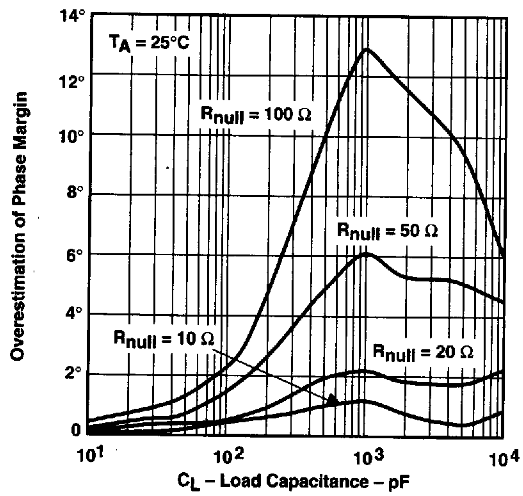


Figure 61

† See application information

APPLICATION INFORMATION

driving large capacitive loads

The TLC226x is designed to drive larger capacitive loads than most CMOS operational amplifiers. Figure 52 and Figure 53 illustrate its ability to drive loads greater than 400 pF while maintaining good gain and phase margins ($R_{null} = 0$).

A smaller series resistor (R_{null}) at the output of the device (see Figure 56) improves the gain and phase margins when driving large capacitive loads. Figure 52 and Figure 53 show the effects of adding series resistances of 10 Ω, 20 Ω, 50 Ω, and 100 Ω. The addition of this series resistor has two effects: the first is that it adds a zero to the transfer function and the second is that it reduces the frequency of the pole associated with the output load in the transfer function.

The zero introduced to the transfer function is equal to the series resistance times the load capacitance. To calculate the improvement in phase margin, equation 1 can be used.

$$\Delta\Theta_{m1} = \tan^{-1}\left(2 \times \pi \times UGBW \times R_{null} \times C_L\right) \tag{1}$$

where :

$\Delta\Theta_{m1}$ = improvement in phase margin
UGBW = unity-gain bandwidth frequency
R_{null} = output series resistance
C_L = load capacitance

The unity-gain bandwidth (UGBW) frequency decreases as the capacitive load increases (see Figure 54). To use equation 1, UGBW must be approximated from Figure 54.

Using equation 1 alone overestimates the improvement in phase margin, as illustrated in Figure 55. The overestimation is caused by the decrease in the frequency of the pole associated with the load, thus providing additional phase shift and reducing the overall improvement in phase margin. The pole associated with the load is reduced by the factor calculated in equation 2.

$$F = \frac{1}{1 + g_m \times R_{null}} \tag{2}$$

where :

F = factor reducing frequency of pole
g_m = small-signal output transconductance (typically 4.83×10^{-3} mhos)
R_{null} = output series resistance

For the TLC226x, the pole associated with the load is typically 7 MHz with 100-pF load capacitance. This value varies inversely with C_L: at C_L = 10 pF, use 70 MHz, at C_L = 1000 pF, use 700 kHz, and so on.

Reducing the pole associated with the load introduces phase shift, thereby reducing phase margin. This results in an error in the increase in phase margin expected by considering the zero alone (equation 1). Equation 3 approximates the reduction in phase margin due to the movement of the pole associated with the load. The result of this equation can be subtracted from the result of the equation in equation 1 to better approximate the improvement in phase margin.

APPLICATION INFORMATION

driving large capacitive loads (continued)

$$\Delta\Theta_{m2} = \tan^{-1}\left[\frac{UGBW}{(F \times P_2)}\right] - \tan^{-1}\left(\frac{UGBW}{P_2}\right) \qquad (3)$$

where :

$\Delta\Theta_{m2}$ = reduction in phase margin

UGBW = unity-gain bandwidth frequency

F = factor from equation 2

P_2 = unadjusted pole (70 MHz@10 pF, 7 MHz@100 pF, etc.)

Using these equations with Figure 54 and Figure 55 enables the designer to choose the appropriate output series resistance to optimize the design of circuits driving large capacitive loads.

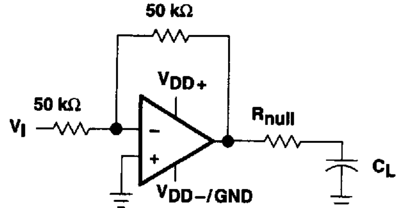


Figure 62. Series-Resistance Circuit

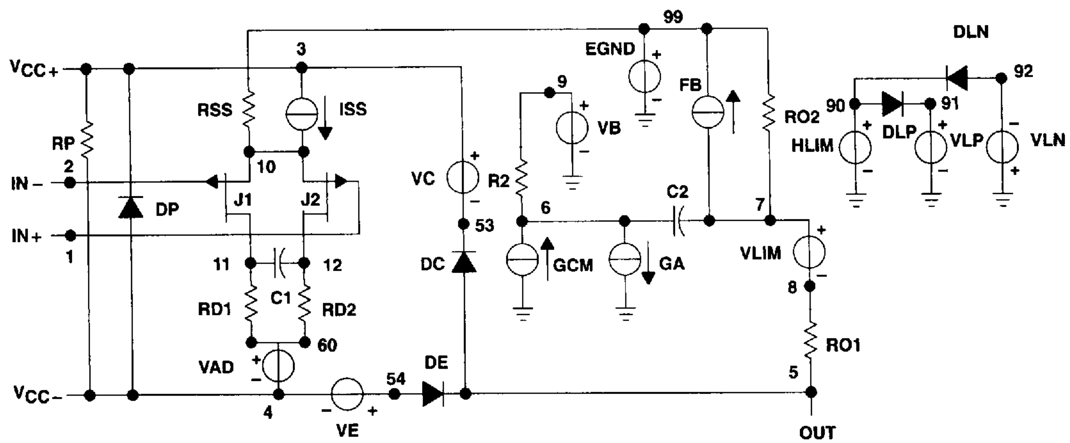
APPLICATION INFORMATION

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 57 are generated using the TLC226x 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).




```
.SUBCKT TLC226x 1 2 3 4 5
    C1      11   12    3.560E-12
    C2      6    7     15.00E-12
    DC      5    53    DX
    DE      54   5     DX
    DLP     90   91    DX
    DLN     92   90    DX
    DP      4    3     DX
    EGND    99   0     POLY (2) (3,0) (4,0) 0 .5 .5
    FB      7    99    POLY (5) VB VC VE VLP
    + VLN 0 21.04E6 -30E6 30E6 30E6 -30E6
    GA      6    0     11    12 47.12E-6
    GCM     0    6     10    99 4.9E-9
    ISS     3    10    DC 8.250E-6
    HLIM    90   0     VLIM 1K
    J1      11   2     10 JX
    J2      12   1     10 JX
    R2      6    9     100.0E3
    RD1     60   11    21.22E3
    RD2     60   12    21.22E3
    R01     8    5     120
    R02     7    99    120
    RP      3    4     26.04E3
    RSS     10   99    24.24E6
    VAD     60   4     -.6
    VB      9    0     DC 0
    VC      3    53    DC .65
    VE      54   4     DC .65
    VLIM    7    8     DC 0
    VLP     91   0     DC 1.4
    VLN     0    92    DC 9.4
    .MODEL DX D (IS=800.0E-18)
    .MODEL JX PJF (IS=500.0E-15 BETA=281E-6
    + VTO=-.065)
    .ENDS
```

Figure 63. Boyle Macromodel and Subcircuit