

TLC226x, TLC226xA Advanced LinCMOS™ RAIL-TO-RAIL OPERATIONAL AMPLIFIERS

SLOS177D – FEBRUARY 1997 – REVISED MARCH 2001

- 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
- Available in Q-Temp Automotive
HighRel Automotive Applications
Configuration Control/Print Support
Qualification to Automotive Standards

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.

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.

EQUIVALENT INPUT NOISE VOLTAGE
VS
FREQUENCY

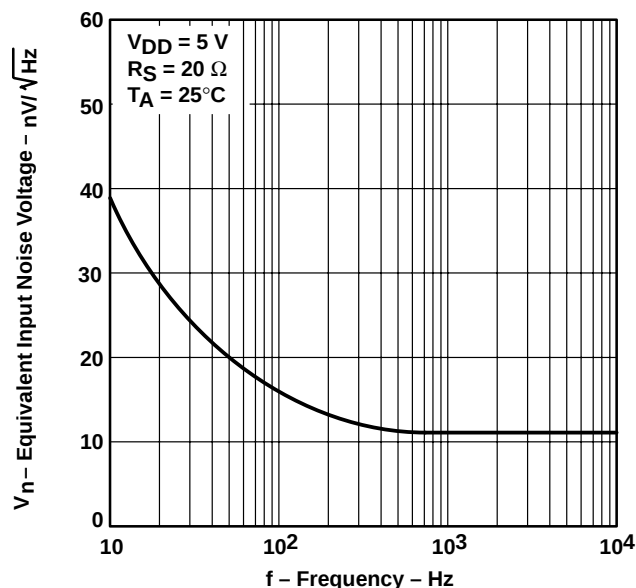


Figure 1



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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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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TLC2262 AVAILABLE OPTIONS

T _A	V _{IO} max AT 25°C	PACKAGED DEVICES					
		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	TLC2262CPW	—
–40°C to 125°C	950 µV 2.5 mV	TLC2262AID TLC2262ID	— —	— —	TLC2262AIP TLC2262IP	TLC2262AIPW —	— —
–40°C to 125°C	950 µV 2.5 mV	TLC2262AQD TLC2262QD	— —	— —	— —	— —	— —
–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					
		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	TLC2264CPW	—
–40°C to 125°C	950 µV 2.5 mV	TLC2264AID TLC2264ID	— —	— —	TLC2264AIN TLC2264IN	TLC2264AIPW —	— —
–40°C to 125°C	950 µV 2.5 mV	TLC2264AQD TLC2264QD	— —	— —	— —	— —	— —
–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.

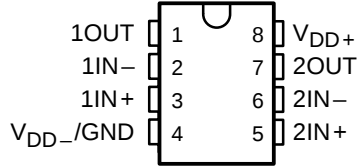


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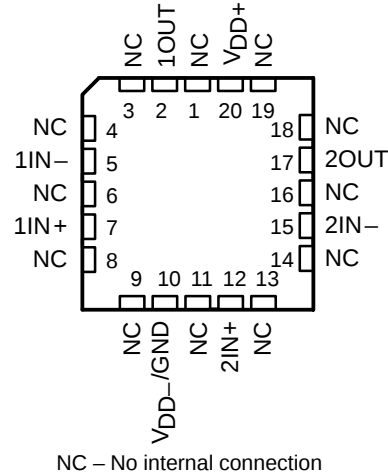
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TLC2262C, TLC2262AC
TLC2262I, TLC2262AI
TLC2262Q, TLC2262AQ
D, P, OR PW PACKAGE
(TOP VIEW)



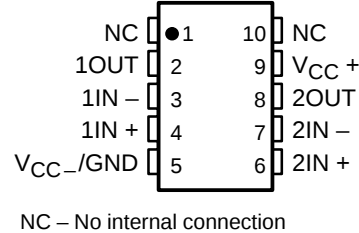
TLC2262M, TLC2262AM . . . FK PACKAGE
(TOP VIEW)



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



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



TLC2264C, TLC2264AC
TLC2264I, TLC2264AI
TLC2264Q, TLC2264AQ
D, N, OR PW PACKAGE
(TOP VIEW)



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



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



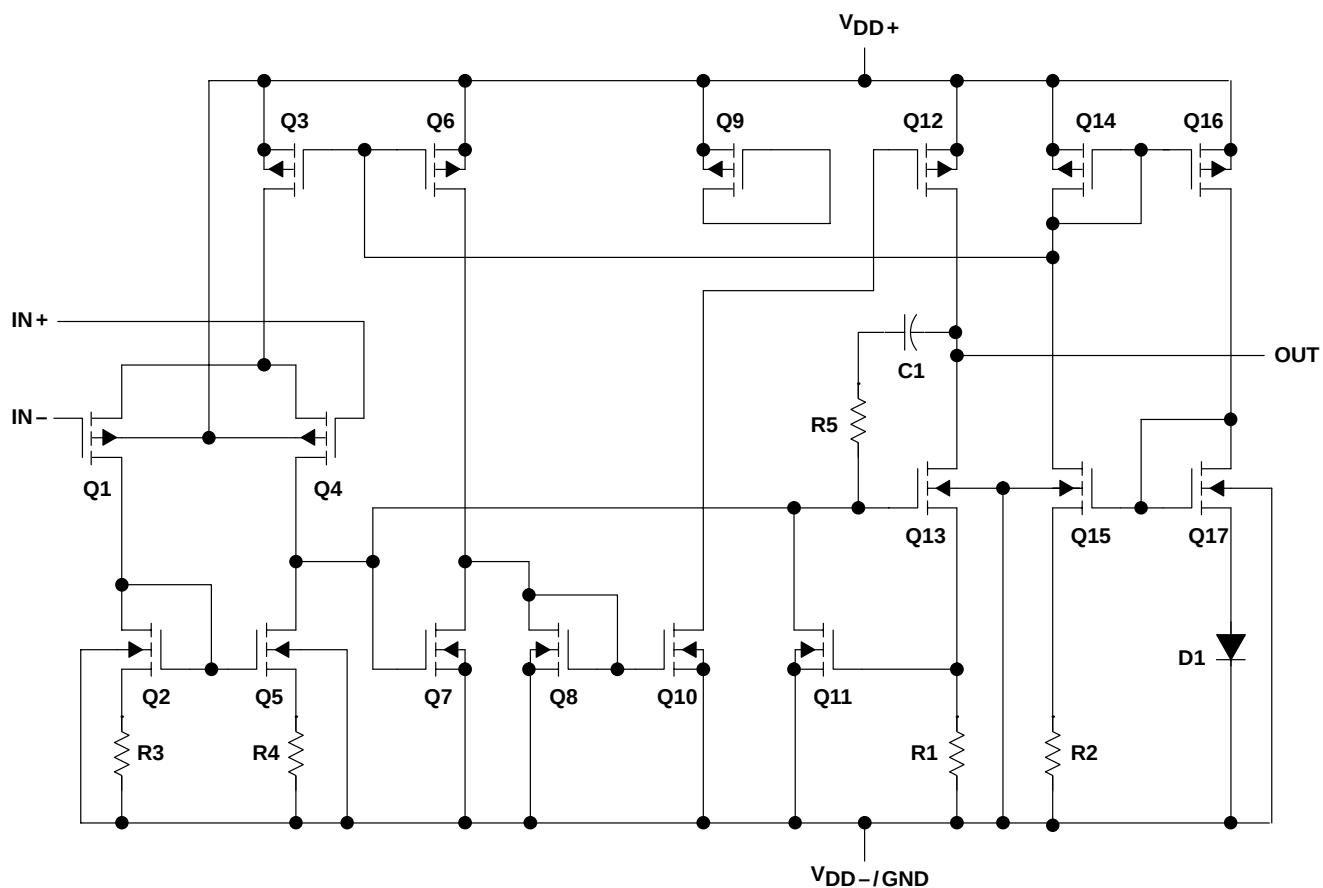
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equivalent schematic (each amplifier)



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

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)	$V_{DD-} - 0.3 \text{ V}$ 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
Q 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 $V_{DD-} - 0.3 \text{ V}$.
3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D–8	725 mW	5.8 mW/°C	464 mW	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		Q SUFFIX		M SUFFIX		UNIT
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{DD\pm}$	±2.2	±8	±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_{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-}	$V_{DD+} - 1.5$	V
Operating free-air temperature, T_A	0	70	–40	125	–40	125	–55	125	°C

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

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2262C			UNIT
			MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{IC} = 0, V_O = 0, V_{DD} \pm = \pm 2.5\text{ V}, R_S = 50\ \Omega$	25°C		300	2500	μV
		Full range			3000	
α_{VIO} Temperature coefficient of input offset voltage		25°C to 70°C		2		$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)		25°C		0.003		$\mu\text{V}/\text{mo}$
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	$R_S = 50\ \Omega, V_{IO} \leq 5\text{ mV}$	25°C	0 to 4	–0.3 to 4.2		V
		Full range	0 to 3.5			
V_{OH} High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C		4.99		V
	$I_{OH} = -100\ \mu\text{A}$	25°C		4.85	4.94	
		Full range		4.82		
	$I_{OH} = -400\ \mu\text{A}$	25°C		4.70	4.85	
V_{OL} Low-level output voltage	$V_{IC} = 2.5\text{ V}, I_{OL} = 50\ \mu\text{A}$	25°C		0.01		V
		25°C		0.09	0.15	
	$V_{IC} = 2.5\text{ V}, I_{OL} = 500\ \mu\text{A}$	Full range			0.15	
		25°C		0.2	0.3	
	$V_{IC} = 2.5\text{ V}, I_{OL} = 1\text{ mA}$	Full range			0.3	
		25°C		0.7	1	
A_{VD} Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}, V_O = 1\text{ V to }4\text{ V}$	$R_L = 50\text{ k}\Omega^\ddagger$	25°C	80	170	V/mV
			Full range	55		
		$R_L = 1\text{ M}\Omega^\ddagger$	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	$f = 10\text{ kHz}, \text{ P package}$	25°C		8		pF
z_o Closed-loop output impedance	$f = 100\text{ kHz}, A_V = 10$	25°C		240		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	70	83		dB
		Full range	70			
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 4.4\text{ V to }16\text{ V}, V_{IC} = V_{DD}/2, \text{ No load}$	25°C	80	95		dB
		Full range	80			
I_{DD} Supply current	$V_O = 2.5\text{ V}, \text{ No load}$	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 $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER		TEST CONDITIONS		$T_A^\dagger$	TLC2262C			UNIT
					MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = 1.5\text{ V to }3.5\text{ V},$ $C_L = 100\text{ pF}^\ddagger$	$R_L = 50\text{ k}\Omega^\ddagger,$	25°C	0.35	0.55		V/ μs
				Full range	0.3			
V_n	Equivalent input noise voltage	$f = 10\text{ Hz}$		25°C		40		$\text{nV}/\sqrt{\text{Hz}}$
		$f = 1\text{ kHz}$		25°C		12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$		25°C		0.7		μV
		$f = 0.1\text{ Hz to }10\text{ Hz}$		25°C		1.3		
I_n	Equivalent input noise current			25°C		0.6		$\text{fA}/\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_O = 0.5\text{ V to }2.5\text{ V},$ $f = 20\text{ kHz},$ $R_L = 50\text{ k}\Omega^\ddagger$	$A_V = 1$	25°C		0.017%		
			$A_V = 10$			0.03%		
	Gain-bandwidth product	$f = 10\text{ kHz},$ $C_L = 100\text{ pF}^\ddagger$	$R_L = 50\text{ k}\Omega^\ddagger,$	25°C		0.71		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)} = 2\text{ V},$ $R_L = 50\text{ k}\Omega^\ddagger,$	$A_V = 1,$ $C_L = 100\text{ pF}^\ddagger$	25°C		185		kHz
t_s	Settling time	$A_V = -1,$ Step = 0.5 V to 2.5 V, $R_L = 50\text{ k}\Omega^\ddagger,$ $C_L = 100\text{ pF}^\ddagger$	To 0.1%	25°C		6.4		μs
			To 0.01%			14.1		
ϕ_m	Phase margin at unity gain	$R_L = 50\text{ k}\Omega^\ddagger,$	$C_L = 100\text{ pF}^\ddagger$	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, $V_{DD\pm} = \pm 5$ V (unless otherwise specified)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2262C			UNIT
			MIN	TYP	MAX	
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		$\mu V/^\circ C$
Input offset voltage long-term drift (see Note 4)		25°C		0.003		$\mu V/mo$
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} \leq 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	
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		
A_{VD} Large-signal differential voltage amplification	$V_O = \pm 4$ V	$R_L = 50$ k Ω	25°C	80	200	V/mV
			Full range	55		
		$R_L = 1$ M Ω	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 $T_A = 150^\circ C$ extrapolated to $T_A = 25^\circ C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262C			UNIT
					MIN	TYP	MAX	
SR	Slew rate at unity gain	V _O = ±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 = ±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.

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

PARAMETER	TEST CONDITIONS	T_A †	TLC2264C			UNIT
			MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{IC} = 0$, $V_O = 0$, $V_{DD} \pm \pm 2.5\text{ V}$, $R_S = 50\ \Omega$	25°C		300	2500	μV
		Full range			3000	
α_{VIO} Temperature coefficient of input offset voltage		25°C to 70°C		2		$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)		25°C		0.003		$\mu\text{V}/\text{mo}$
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	$R_S = 50\ \Omega$, $ V_{IO} \leq 5\text{ mV}$	25°C	0 to 4	–0.3 to 4.2		V
		Full range	0 to 3.5			
V_{OH} High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C		4.99		V
	$I_{OH} = -100\ \mu\text{A}$	25°C		4.85	4.94	
		Full range		4.82		
	$I_{OH} = -400\ \mu\text{A}$	25°C		4.70	4.85	
		Full range		4.60		
V_{OL} Low-level output voltage	$V_{IC} = 2.5\text{ V}$, $I_{OL} = 50\ \mu\text{A}$	25°C		0.01		V
	$V_{IC} = 2.5\text{ V}$, $I_{OL} = 500\ \mu\text{A}$	25°C		0.09	0.15	
		Full range			0.15	
	$V_{IC} = 2.5\text{ V}$, $I_{OL} = 1\text{ mA}$	25°C		0.2	0.3	
		Full range			0.3	
	$V_{IC} = 2.5\text{ V}$, $I_{OL} = 4\text{ mA}$	25°C		0.7	1	
		Full range			1.2	
A_{VD} Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}$, $V_O = 1\text{ V to }4\text{ V}$	$R_L = 50\text{ k}\Omega^\ddagger$	25°C	80	170	V/mV
			Full range	55		
		$R_L = 1\text{ M}\Omega^\ddagger$	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	$f = 10\text{ kHz}$, N package	25°C		8		pF
z_o Closed-loop output impedance	$f = 100\text{ kHz}$, $A_V = 10$	25°C		240		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	70	83		dB
		Full range	70			
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 4.4\text{ V to }16\text{ V}$, $V_{IC} = V_{DD}/2$, No load	25°C	80	95		dB
		Full range	80			
I_{DD} Supply current (four amplifiers)	$V_O = 2.5\text{ V}$, 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 $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER		TEST CONDITIONS		T_A †	TLC2264C			UNIT
					MIN	TYP	MAX	
SR	Slew rate at unity gain	$V_O = 1.4\text{ V to }2.6\text{ V}$, $R_L = 50\text{ k}\Omega^\ddagger$, $C_L = 100\text{ pF}^\ddagger$		25°C	0.35	0.55		V/ μs
				Full range	0.3			
V_n	Equivalent input noise voltage	$f = 10\text{ Hz}$ $f = 1\text{ kHz}$		25°C		40		nV/ $\sqrt{\text{Hz}}$
				25°C		12		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$		25°C		0.7		μV
				25°C		1.3		
I_n	Equivalent input noise current			25°C		0.6		fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_O = 0.5\text{ V to }2.5\text{ V}$, $f = 20\text{ kHz}$, $R_L = 50\text{ k}\Omega^\ddagger$	$A_V = 1$	25°C		0.017%		
			$A_V = 10$			0.03%		
	Gain-bandwidth product	$f = 10\text{ kHz}$, $C_L = 100\text{ pF}^\ddagger$	$R_L = 50\text{ k}\Omega^\ddagger$	25°C		0.71		MHz
BOM	Maximum output-swing bandwidth	$V_{O(PP)} = 2\text{ V}$, $R_L = 50\text{ k}\Omega^\ddagger$	$A_V = 1$, $C_L = 100\text{ pF}^\ddagger$	25°C		185		kHz
t_s	Settling time	$A_V = -1$, Step = $0.5\text{ V to }2.5\text{ V}$, $R_L = 50\text{ k}\Omega^\ddagger$, $C_L = 100\text{ pF}^\ddagger$	To 0.1%	25°C		6.4		μs
			To 0.01%			14.1		
ϕ_m	Phase margin at unity gain	$R_L = 50\text{ k}\Omega^\ddagger$	$C_L = 100\text{ pF}^\ddagger$	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, $V_{DD\pm} = \pm 5$ V (unless otherwise specified)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2264C			UNIT
			MIN	TYP	MAX	
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		$\mu V/^\circ C$
Input offset voltage long-term drift (see Note 4)		25°C		0.003		$\mu V/mo$
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} \leq 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	
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	
A_{VD} Large-signal differential voltage amplification	$V_O = \pm 4$ V	$R_L = 50$ k Ω	25°C	80	200	V/mV
			Full range	55		
		$R_L = 1$ M Ω	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, $V_O = 0, R_S = 50 \Omega$	25°C		75	88	dB
		Full range		75		
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{DD\pm} / \Delta V_{IO}$)	$V_{DD\pm} = \pm 2.2$ 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 $T_A = 150^\circ C$ extrapolated to $T_A = 25^\circ C$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2264C			UNIT
					MIN	TYP	MAX	
SR	Slew rate at unity gain	V _O = ±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 = ± 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, $V_{DD} = 5\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262I			TLC2262AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage	V _{DD±} = ±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		
				85°C	150		150				
				Full range	800		800		pA		
I _{IB}	Input bias current			25°C	1		1		pA		
				85°C	150		150		pA		
				Full range	800		800		pA		
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				

† 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 $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262I			TLC2262AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
k _{SVR}	Supply-voltage re- jection ratio (ΔV _{DD} /ΔV _{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	
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		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 $-40^\circ\text{C to }125^\circ\text{C}.$

‡ Referenced to 2.5 V

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

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262I			TLC2262AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage	V _{IC} = 0, V _O = 0 R _S = 50 Ω		25°C	300	2500		300	950	μV	
	Full range				3000		1500				
αV _{IO}	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		
				85°C		150		150		pA	
				Full range		800		800		pA	
I _{IB}	Input bias current			25°C	1		1		pA		
				85°C		150		150		pA	
				Full range		800		800		pA	
V _{ICR}	Common-mode input voltage range	R _S = 50 Ω, V _{IO} ≤ 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 μA		25°C	4.99		4.99		V		
		I _O = –100 μA		25°C	4.85	4.94	4.85	4.94			
				Full range	4.82		4.82				
		I _O = –400 μA		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 μA		25°C	–4.99		–4.99		V		
		V _{IC} = 0, I _O = 500 μA		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 = ±4 V	R _L = 50 kΩ	25°C	80	200	80	200	V/mV		
			R _L = 1 MΩ	Full range	50		50				
				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 Ω		25°C	75	88	75	88	dB		
				Full range	75		75				
k _{SVR}	Supply-voltage rejection ratio (ΔV _{DD±} /ΔV _{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				

[†] 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 $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER	TEST CONDITIONS		$T_A^\dagger$	TLC2262I			TLC2262AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
I_{DD} Supply Current	$V_O = 2.5\text{ V}$, No load		25°C		425	500		425	500	
			Full range			500			500	
SR Slew rate at unity gain	$V_O = \pm 1.9\text{ V}$, $R_L = 50\text{ k}\Omega$, $C_L = 100\text{ pF}$		25°C	0.35	0.55		0.35	0.55		V/ μs
			Full range	0.25			0.25			
V_n Equivalent input noise voltage	$f = 10\text{ Hz}$ $f = 1\text{ kHz}$		25°C		43			43		nV/ $\sqrt{\text{Hz}}$
			25°C		12			12		
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$f = 0.1\text{ Hz to }1\text{ Hz}$ $f = 0.1\text{ Hz to }10\text{ Hz}$		25°C		0.8			0.8		μV
			25°C		1.3			1.3		
I_n Equivalent input noise current			25°C		0.6			0.6		fA/ $\sqrt{\text{Hz}}$
THD + N Total harmonic distortion plus noise	$V_O = \pm 2.3\text{ V}$, $R_L = 50\text{ k}\Omega$, $f = 20\text{ kHz}$	$A_V = 1$	25°C		0.014%			0.014%		
		$A_V = 10$			0.024%			0.024%		
Gain-bandwidth product	$f = 10\text{ kHz}$, $C_L = 100\text{ pF}$	$R_L = 50\text{ k}\Omega$	25°C		0.73			0.73		MHz
B_{OM} Maximum output-swing bandwidth	$V_{O(PP)} = 4.6\text{ V}$, $R_L = 50\text{ k}\Omega$	$A_V = 1$, $C_L = 100\text{ pF}$	25°C		85			85		kHz
t_s Settling time	$A_V = -1$, Step = $-2.3\text{ V to }2.3\text{ V}$, $R_L = 50\text{ k}\Omega$, $C_L = 100\text{ pF}$	To 0.1%	25°C		7.1			7.1		μs
		To 0.01%			16.5			16.5		
ϕ_m Phase margin at unity gain	$R_L = 50\text{ k}\Omega$	$C_L = 100\text{ pF}$	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, $V_{DD} = 5\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2264I			TLC2264AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{DD} \pm \pm 2.5\text{ V}, V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	25°C	300	2500		300	950		μV
		Full range		3000			1500		
α_{VIO} Temperature coefficient of input offset voltage		25°C to 125°C	2			2			$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)		25°C	0.003			0.003			$\mu\text{V}/\text{mo}$
I_{IO} Input offset current		25°C	0.5			0.5			pA
		85°C		150			150		
		Full range		800			800		
I_{IB} Input bias current		25°C	1			1			pA
		85°C		150			150		
		Full range		800			800		
V_{ICR} Common-mode input voltage range	$R_S = 50\ \Omega, V_{IO} \leq 5\text{ mV}$	25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
		Full range	0 to 3.5			0 to 3.5			
V_{OH} High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C		4.99			4.99		V
	$I_{OH} = -100\ \mu\text{A}$	25°C	4.85	4.94		4.85	4.94		
		Full range	4.82			4.82			
	$I_{OH} = -400\ \mu\text{A}$	25°C	4.7	4.85		4.7	4.85		
		Full range	4.5			4.5			
V_{OL} Low-level output voltage	$V_{IC} = 2.5\text{ V}, I_{OL} = 50\ \mu\text{A}$	25°C		0.01			0.01		V
	$V_{IC} = 2.5\text{ V}, I_{OL} = 500\ \mu\text{A}$	25°C		0.09	0.15		0.09	0.15	
		Full range			0.15			0.15	
	$V_{IC} = 2.5\text{ V}, I_{OL} = 4\text{ mA}$	25°C		0.8	1		0.7	1	
		Full range			1.2			1.2	
A_{VD} Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}, V_O = 1\text{ V to }4\text{ V}$	$R_L = 50\text{ k}\Omega^\ddagger$	25°C	80	100	80	170		V/mV
			Full range	50		50			
		$R_L = 1\text{ M}\Omega^\ddagger$	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	$f = 10\text{ kHz}, \text{ N package}$	25°C		8			8		pF
z_o Closed-loop output impedance	$f = 100\text{ kHz}, A_V = 10$	25°C		240			240		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	70	83		70	83		dB
		Full range	70			70			
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 4.4\text{ V to }16\text{ V}, V_{IC} = V_{DD}/2, \text{ No load}$	25°C	80	95		80	95		dB
		Full range	80			80			

† 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 $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV .



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

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2264I			TLC2264AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
I _{DD}	Supply current (four amplifiers)	V _O = 2.5 V,	No load	25°C	0.8		1	0.8		1	V/μs
				Full range			1			1	
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		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	0.71			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			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 $-40^\circ\text{C to } 125^\circ\text{C}$.

‡ Referenced to 2.5 V

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TLC2264I electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5\text{ V}$ (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 Ω		25°C	300 2500		300 950		μV		
	Full range			3000		1500					
αV _{IO}	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		
				85°C	150		150				
				Full range	800		800				
I _{IB}	Input bias current			25°C	1		1		pA		
				85°C	150		150		pA		
				Full range	800		800		pA		
V _{ICR}	Common-mode input voltage range	R _S = 50 Ω, V _{IO} ≤ 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 μA		25°C	4.99		4.99		V		
		I _O = -100 μA		25°C	4.85 4.94	4.85 4.94					
				Full range	4.82		4.82				
		I _O = -400 μA		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 μA		25°C	-4.99		-4.99		V		
		V _{IC} = 0, I _O = 500 μA		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 = ±4 V	R _L = 50 kΩ	25°C	80 200	80 200		V/mV			
			R _L = 1 MΩ	Full range	50	50					
					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 Ω		25°C	75 88	75 88		dB			
				Full range	75	75					
k _{SVR}	Supply-voltage rejection ratio (ΔV _{DD±} /ΔV _{IO})	V _{DD±} = ±2.2 V to ±8 V, V _{IC} =V _{DD} /2, No load		25°C	80 95	80 95		dB			
				Full range	80	80					

† 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 $T_A = 150^\circ\text{C}$ extrapolated to $T_A = 25^\circ\text{C}$ using the Arrhenius equation and assuming an activation energy of 0.96 eV.



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

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2264I			TLC2264AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
I _{DD}	Supply current (four amplifiers)	V _O = 0, No load		25°C	0.85		1	0.85		1	
				Full range			1			1	
SR	Slew rate at unity gain	V _O = ±1.9 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	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 = ±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, R _L = 50 kΩ, C _L = 100 pF		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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TLC2262Q/M electrical characteristics at specified free-air temperature, $V_{DD} = 5\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262Q, TLC2262M			TLC2262AQ, TLC2262AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V _{IO}	Input offset voltage	V _{DD±} = ±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	800			800			
I _{IB}	Input bias current			25°C	1			1			pA
				125°C	800			800			
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 (ΔV _{DD} /ΔV _{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 for Q suffix, -55°C to 125°C for M suffix.

‡ Referenced to 2.5 V

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



TLC2262Q/M operating characteristics at specified free-air temperature, $V_{DD} = 5\text{ V}$

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262Q, TLC2262M			TLC2262AQ, TLC2262AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
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, 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 -40°C to 125°C for Q suffix, -55°C to 125°C for M suffix.

‡ Referenced to 2.5 V

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TLC2262Q/M electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2262Q, TLC2262M			TLC2262AQ, TLC2262AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{IC} = 0, \quad V_O = 0, \quad R_S = 50 \Omega$	25°C	300	2500		300	950		μV
		Full range		3000			1500		
α_{VIO} Temperature coefficient of input offset voltage		Full range	5			5			$\mu V/^\circ C$
Input offset voltage long-term drift (see Note 4)		25°C	0.003			0.003			$\mu V/mo$
I_{IO} Input offset current		25°C	0.5			0.5			pA
		125°C		800			800		
I_{IB} Input bias current		25°C	1			1			pA
		125°C		800			800		
V_{ICR} Common-mode input voltage range	$R_S = 50 \Omega, \quad V_{IO} \leq 5$ mV	25°C	–5 to 4	–5.3 to 4		–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	$V_{IC} = 0, \quad I_O = 50 \mu A$	25°C	–4.99			–4.99			V
	$V_{IC} = 0, \quad I_O = 500 \mu A$	25°C	–4.85	–4.91		–4.85	–4.91		
		Full range	–4.85			–4.85			
	$V_{IC} = 0, \quad I_O = 4$ 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 Ω	25°C	80	200	80	200		V/mV
			Full range	50		50			
		$R_L = 1$ M Ω	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, $V_O = 0, \quad R_S = 50 \Omega$	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	$V_O = 0, \quad$ No load	25°C	425	500		425	500		μA
		Full range		500			500		

† Full range is –40°C to 125°C for Q suffix, –55°C to 125°C for M suffix.

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



TLC2262Q/M operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5\text{ V}$

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2262Q, TLC2262M			TLC2262AQ, TLC2262AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V _O = ±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 = ±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	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 for Q suffix, -55°C to 125°C for M suffix.

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TLC2264Q/M electrical characteristics at specified free-air temperature, $V_{DD} = 5\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2264Q, TLC2264M			TLC2264AQ, TLC2264AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO} Input offset voltage	$V_{DD} = \pm 2.5\text{ V}, V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	25°C	300	2500		300	950		μV
		Full range		3000			1500		
α_{VIO} Temperature coefficient of input offset voltage		Full range		2			2		$\mu\text{V}/^\circ\text{C}$
Input offset voltage long-term drift (see Note 4)		25°C		0.003			0.003		$\mu\text{V}/\text{mo}$
I_{IO} Input offset current		25°C		0.5			0.5		pA
		125°C			800			800	
I_{IB} Input bias current		25°C		1			1		pA
		125°C			800			800	
V_{ICR} Common-mode input voltage range		25°C	0 to 4	-0.3 to 4.2		0 to 4	-0.3 to 4.2		V
		Full range	0 to 3.5			0 to 3.5			
V_{OH} High-level output voltage	$I_{OH} = -20\ \mu\text{A}$	25°C		4.99			4.99		V
	$I_{OH} = -100\ \mu\text{A}$	25°C	4.85	4.94		4.85	4.94		
		Full range	4.82			4.82			
	$I_{OH} = -400\ \mu\text{A}$	25°C	4.7	4.85		4.7	4.85		
		Full range	4.5			4.5			
V_{OL} Low-level output voltage	$V_{IC} = 2.5\text{ V}, I_{OL} = 50\ \mu\text{A}$	25°C		0.01			0.01		V
	$V_{IC} = 2.5\text{ V}, I_{OL} = 500\ \mu\text{A}$	25°C		0.09	0.15		0.09	0.15	
		Full range			0.15			0.15	
	$V_{IC} = 2.5\text{ V}, I_{OL} = 4\text{ mA}$	25°C		0.8	1		0.7	1	
		Full range			1.2			1.2	
A_{VD} Large-signal differential voltage amplification	$V_{IC} = 2.5\text{ V}, V_O = 1\text{ V to }4\text{ V}$	$R_L = 50\text{ k}\Omega^\ddagger$	25°C	80	100		80	170	V/mV
			Full range	50			50		
		$R_L = 1\text{ M}\Omega^\ddagger$	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	$f = 10\text{ kHz}, \text{ N package}$	25°C		8			8		pF
z_o Closed-loop output impedance	$f = 100\text{ kHz}, A_V = 10$	25°C		240			240		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	70	83		70	83		dB
		Full range	70			70			
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	$V_{DD} = 4.4\text{ V to }16\text{ V}$	25°C	80	95		80	95		dB
I_{DD} Supply current (four amplifiers)	$V_O = 2.5\text{ V}, \text{ No load}$	25°C		0.8	1		0.8	1	mA
		Full range			1			1	

† Full range is -40°C to 125°C for Q suffix, -55°C to 125°C for M suffix.

‡ Referenced to 2.5 V

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



TLC2264Q/M operating characteristics at specified free-air temperature, $V_{DD} = 5\text{ V}$

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2264Q, TLC2264M			TLC2264AQ, TLC2264AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
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 [‡]		25°C	0.017%			0.017%			
					0.03%			0.03%			
	Gain-bandwidth product	f = 50 kHz, C _L = 100 pF [‡] , R _L = 50 kΩ [‡]		25°C	0.71			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			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 [‡]		25°C	6.4			6.4			μs
					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 for Q suffix, -55°C to 125°C for M suffix.

‡ Referenced to 2.5 V

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TLC2264Q/M electrical characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5$ V (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLC2264Q, TLC2264M			TLC2264AQ, TLC2264AM			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		Full range		2		2			$\mu V/^\circ C$
Input offset voltage long-term drift (see Note 4)		25°C		0.003		0.003			$\mu V/mo$
I_{IO} Input offset current		25°C		0.5		0.5			pA
		125°C		800		800			
I_{IB} Input bias current		25°C		1		1			pA
		125°C		800		800			
V_{ICR} Common-mode input voltage range	$R_S = 50 \Omega, V_{IO} \leq 5$ mV	25°C	–5 to 4	–5.3 to 4.2		–5 to 4	–5.3 to 4.2		V
		Full range	–5 to 3.5			–5 to 3.5			
V_{OM+} Maximum positive peak output voltage	$I_O = -20 \mu A$	25°C		4.99		4.99			V
	$I_O = -100 \mu A$	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 Ω	25°C	80	200	80	200		V/mV
			Full range	50		50			
		$R_L = 1$ M Ω	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 $-40^\circ C$ to $125^\circ C$ for Q suffix, $-55^\circ C$ to $125^\circ C$ for M suffix.

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



TLC2264Q/M operating characteristics at specified free-air temperature, $V_{DD\pm} = \pm 5\text{ V}$

PARAMETER		TEST CONDITIONS		T _A [†]	TLC2264Q, TLC2264M			TLC2264AQ, TLC2264AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V _O = ±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 = ±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 for Q suffix, -55°C to 125°C for M suffix.

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TYPICAL CHARACTERISTICS

**DISTRIBUTION OF TLC2262
INPUT OFFSET VOLTAGE**



Figure 2

**DISTRIBUTION OF TLC2262
INPUT OFFSET VOLTAGE**



Figure 3

**DISTRIBUTION OF TLC2264
INPUT OFFSET VOLTAGE**

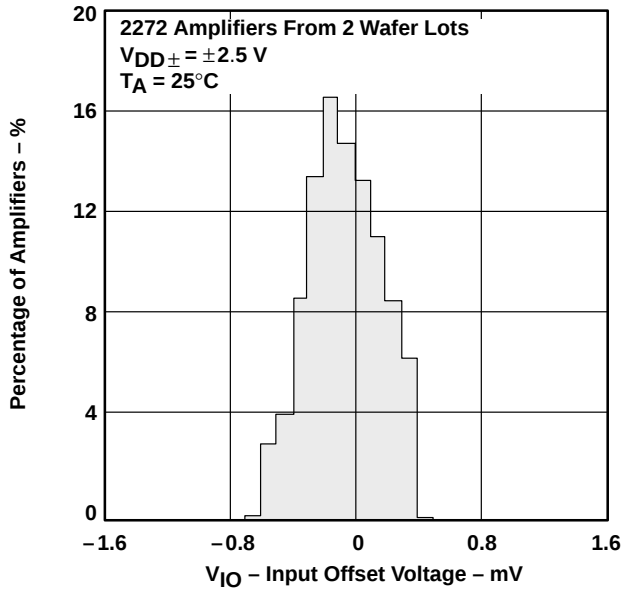


Figure 4

**DISTRIBUTION OF TLC2264
INPUT OFFSET VOLTAGE**

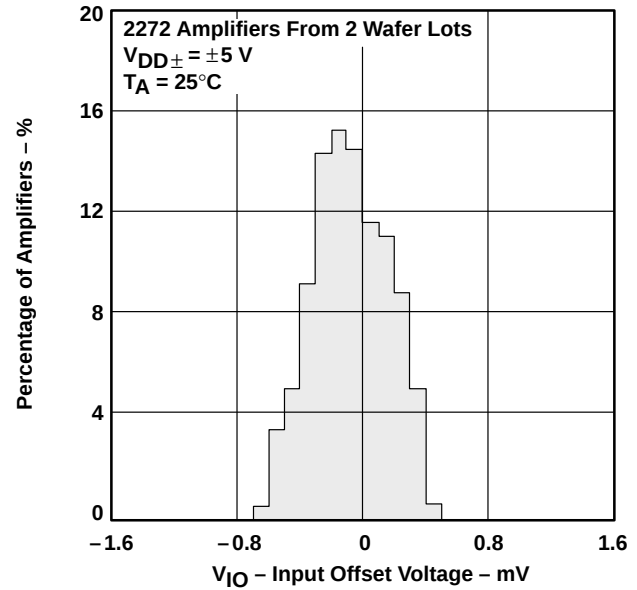


Figure 5

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

Figure 6



Figure 7



Figure 8



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

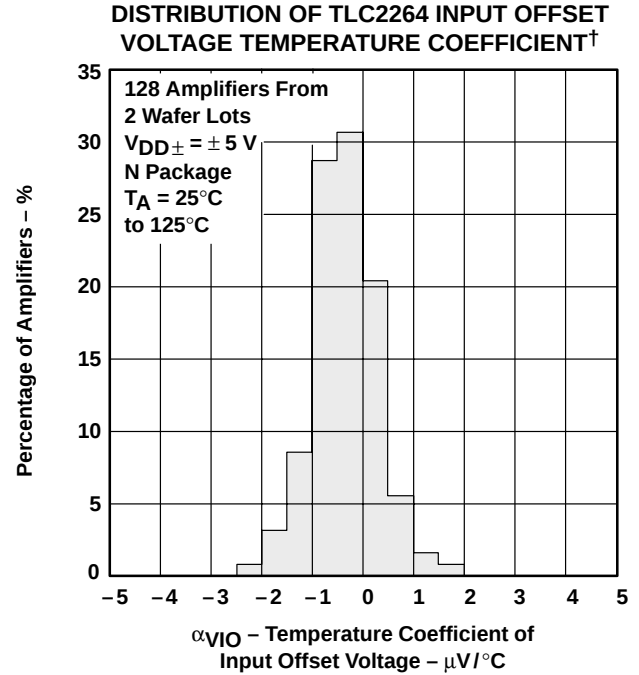


Figure 11



Figure 12



Figure 13

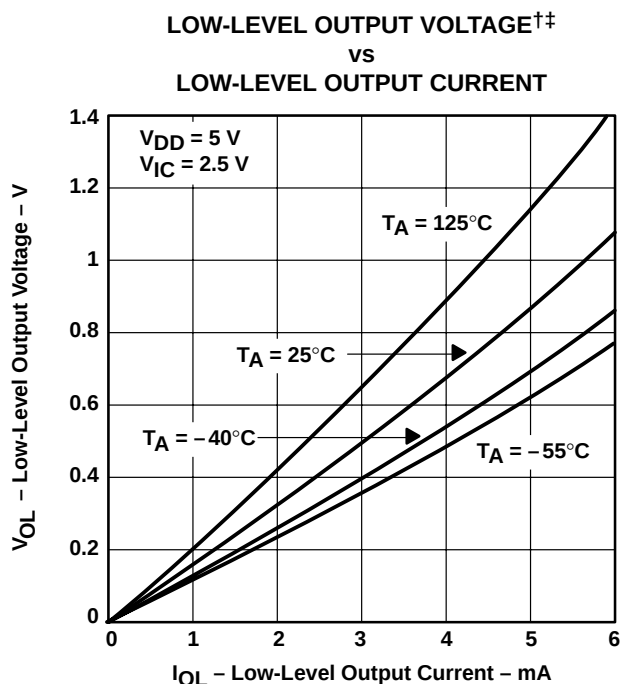
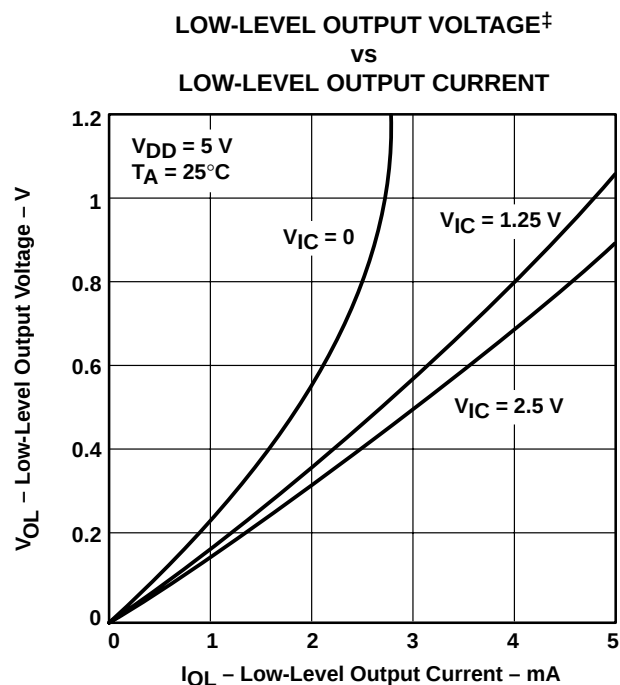
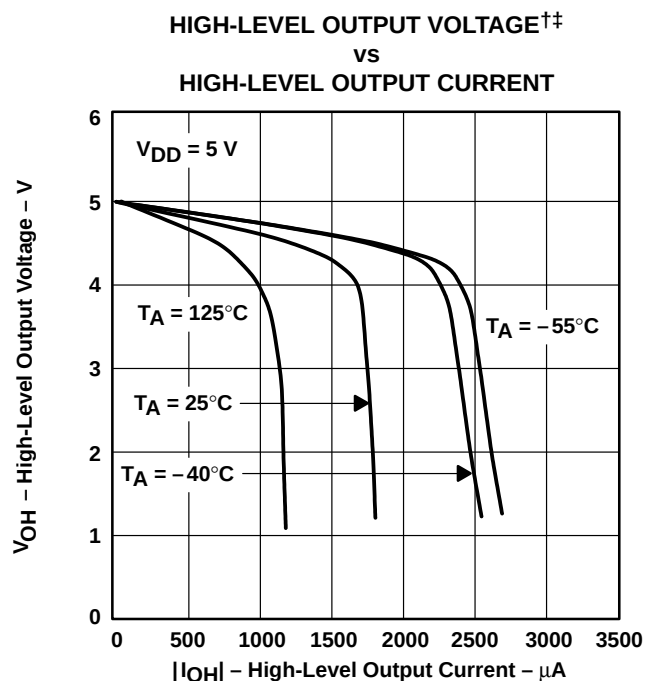
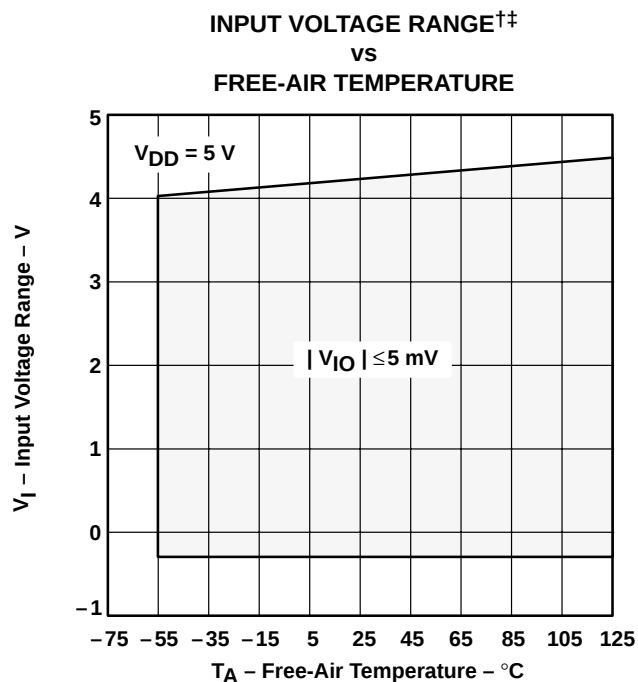
† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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[†] 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



[†] 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.

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TYPICAL CHARACTERISTICS



Figure 22



Figure 23



Figure 24



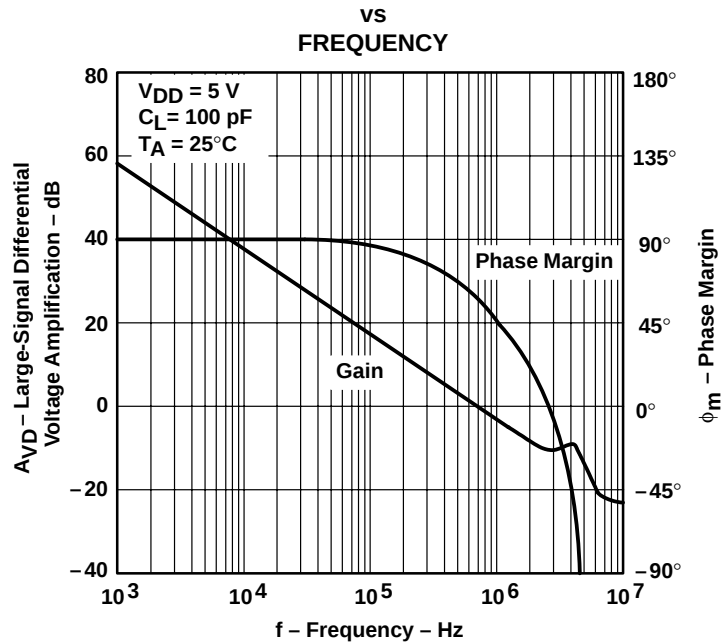
Figure 25

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

[‡] For curves where $V_{DD} = 5 \text{ V}$, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE[†] AMPLIFICATION AND PHASE MARGIN



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

Figure 26

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE MARGIN

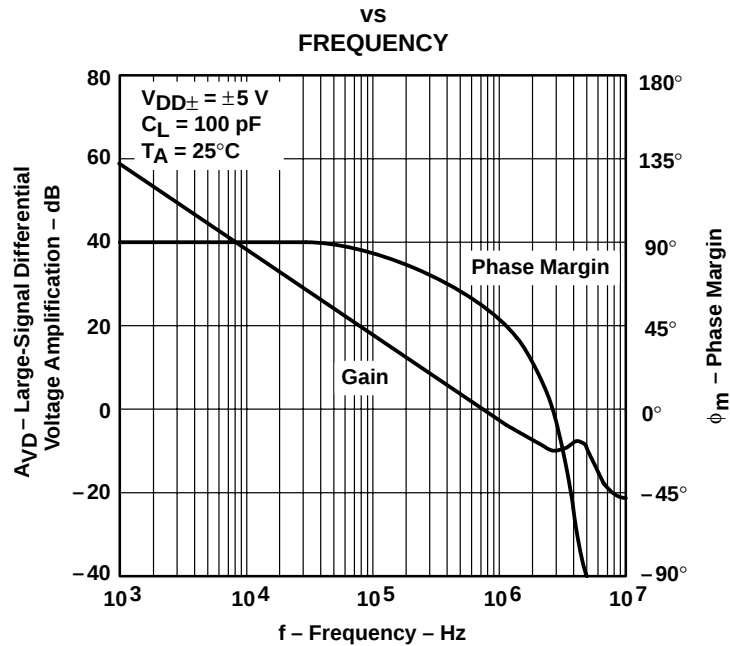


Figure 27

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TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION†‡

VS
FREE-AIR TEMPERATURE



Figure 28

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION†

VS
FREE-AIR TEMPERATURE

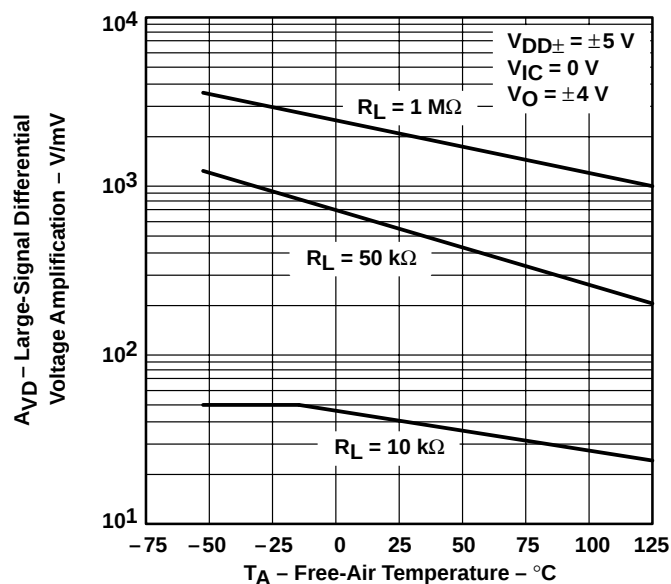


Figure 29

OUTPUT IMPEDANCE‡

VS
FREQUENCY

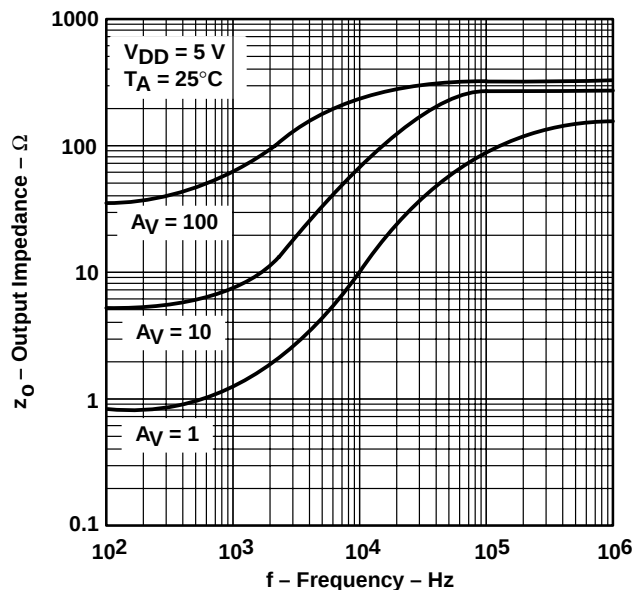


Figure 30

OUTPUT IMPEDANCE

VS
FREQUENCY

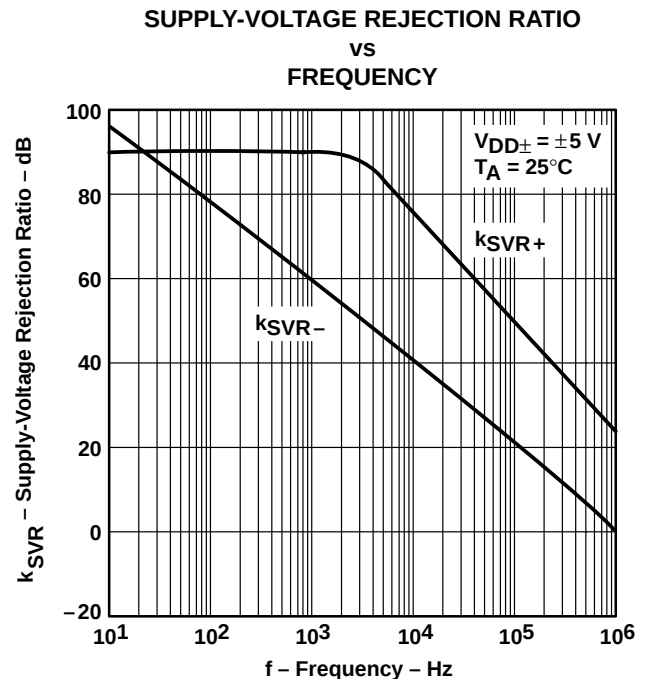
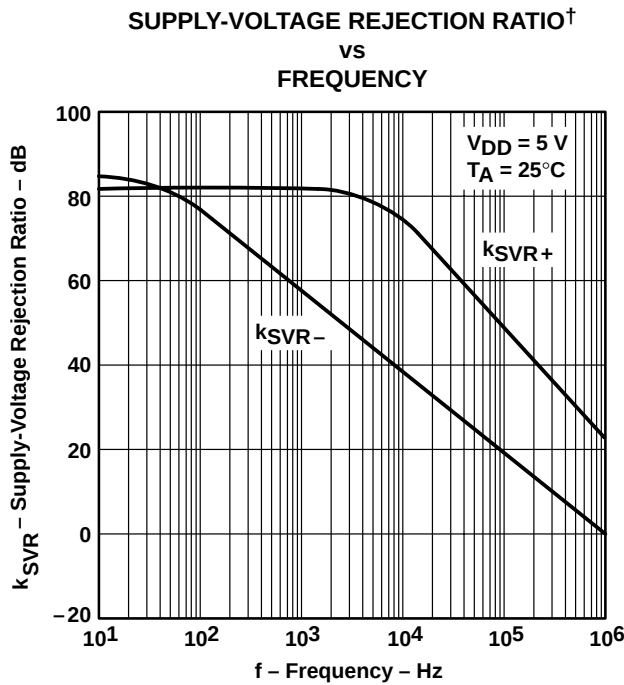
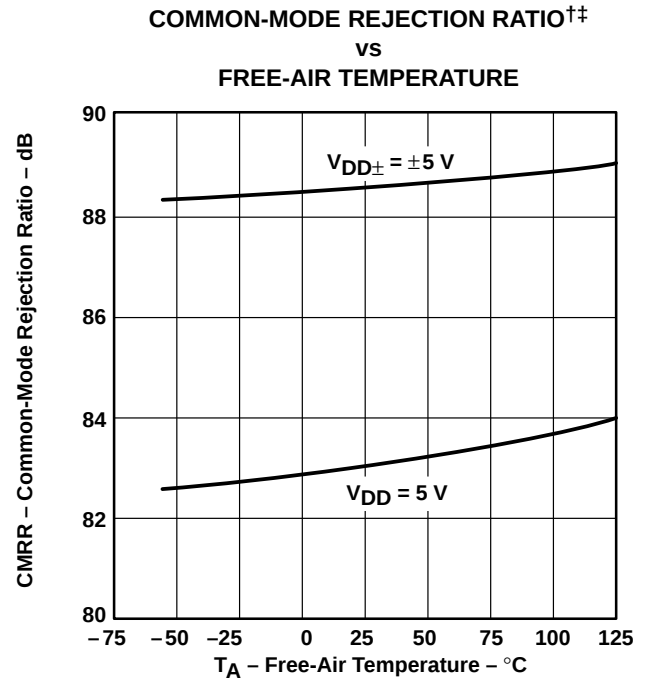


Figure 31

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

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

TYPICAL CHARACTERISTICS



† For curves where $V_{DD} = 5\text{ V}$, 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.

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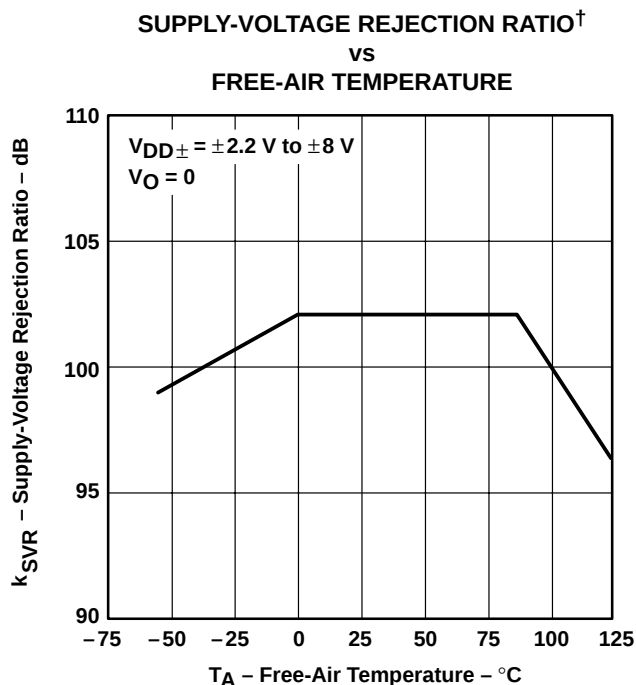


Figure 36



Figure 37



Figure 38



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 $V_{DD} = 5 \text{ V}$, all loads are referenced to 2.5 V.

TYPICAL CHARACTERISTICS



Figure 40

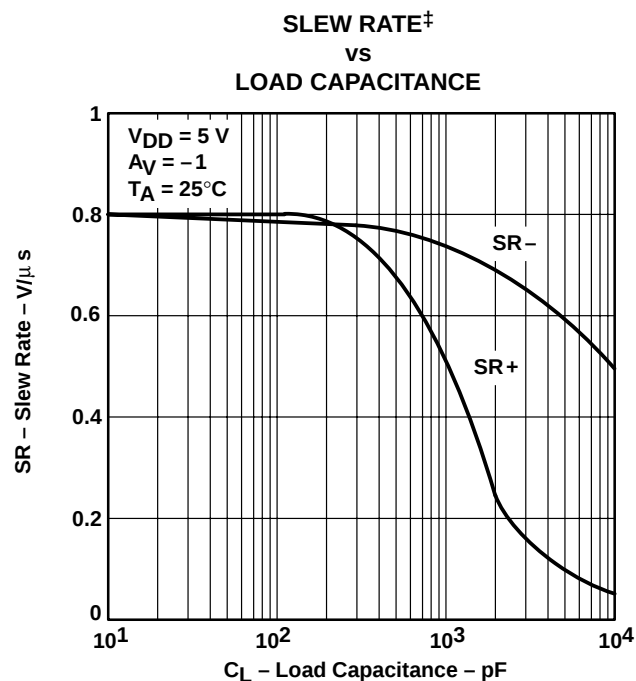


Figure 41

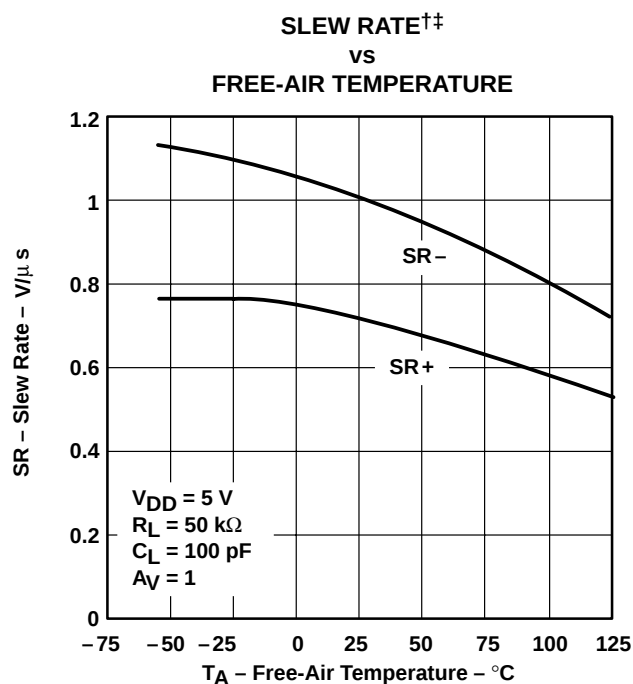


Figure 42

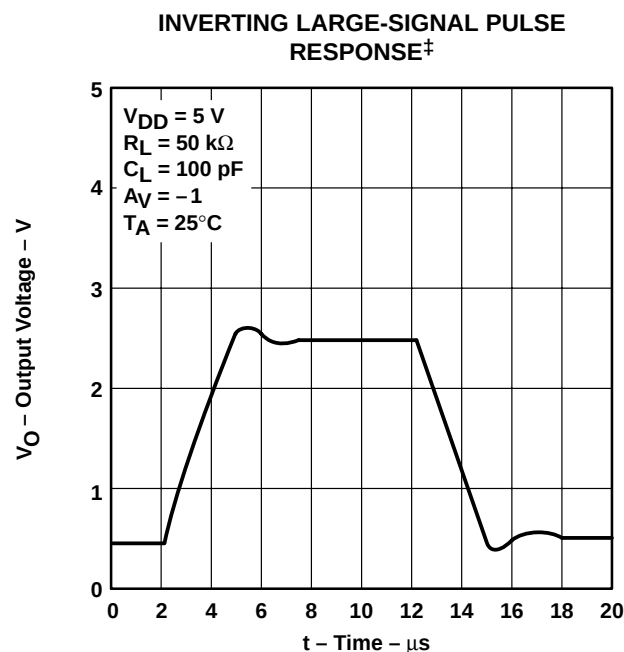


Figure 43

† 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.

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TYPICAL CHARACTERISTICS

INVERTING LARGE-SIGNAL PULSE RESPONSE



Figure 44

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE†

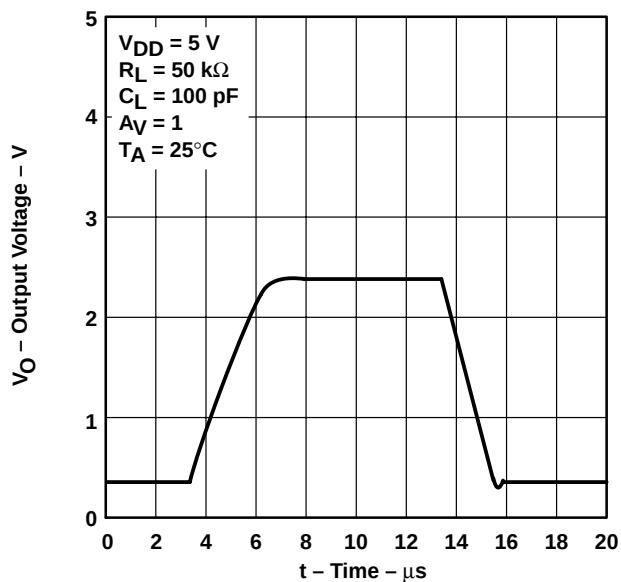


Figure 45

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE



Figure 46

INVERTING SMALL-SIGNAL PULSE RESPONSE†

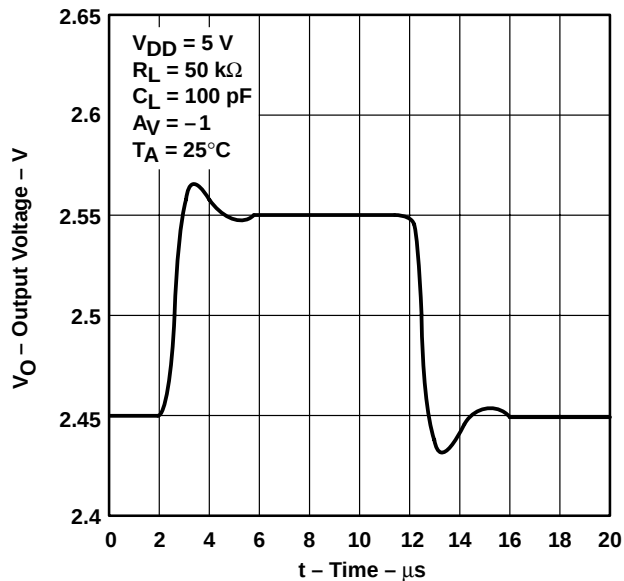


Figure 47

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

TYPICAL CHARACTERISTICS



Figure 48

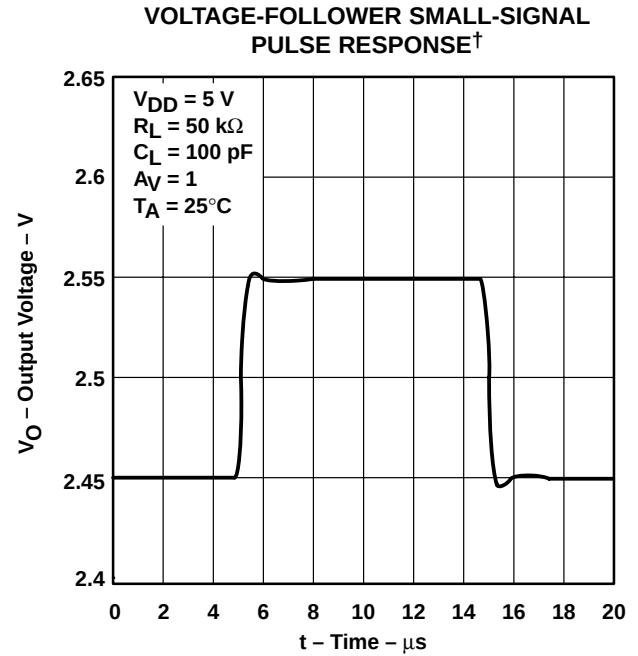


Figure 49



Figure 50



Figure 51

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

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**EQUIVALENT INPUT NOISE VOLTAGE
VS
FREQUENCY**

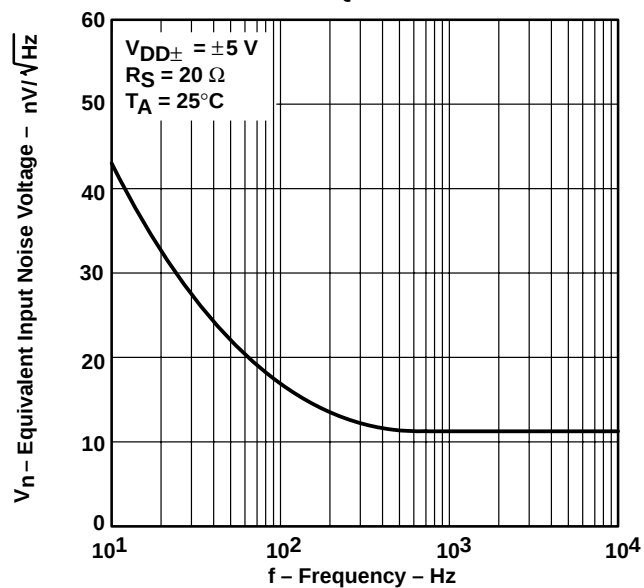


Figure 52

**EQUIVALENT INPUT NOISE VOLTAGE OVER
A 10-SECOND PERIOD†**

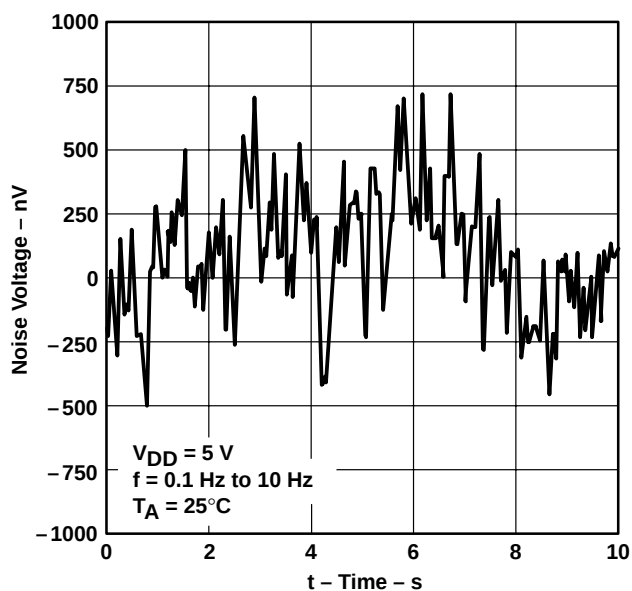


Figure 53

**INTEGRATED NOISE VOLTAGE
VS
FREQUENCY**

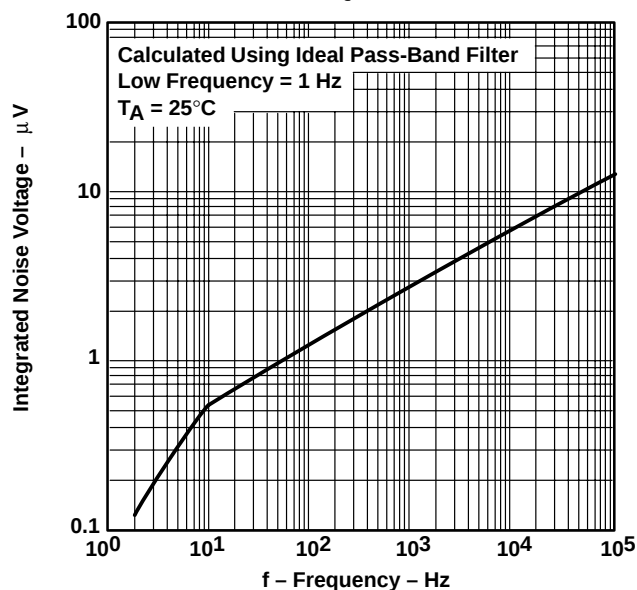


Figure 54

**TOTAL HARMONIC DISTORTION PLUS NOISE†
VS
FREQUENCY**

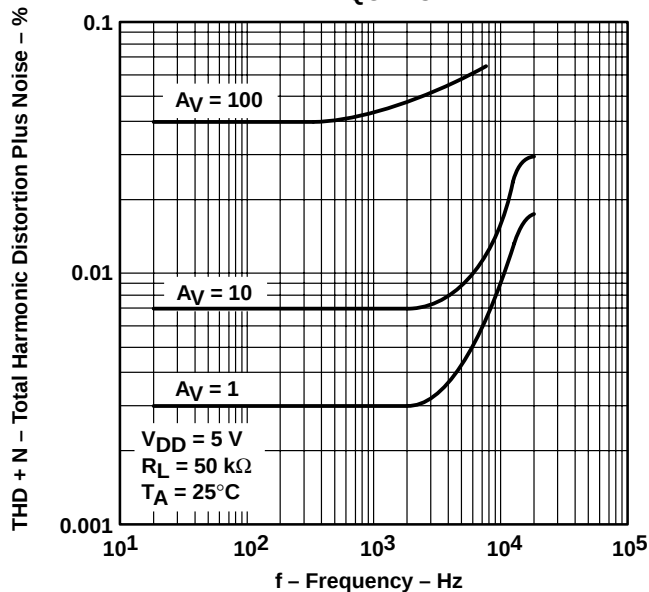
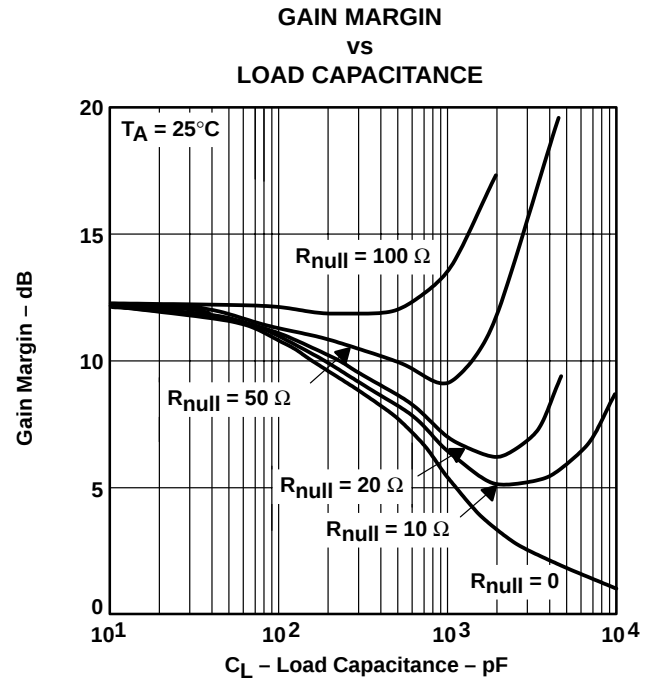
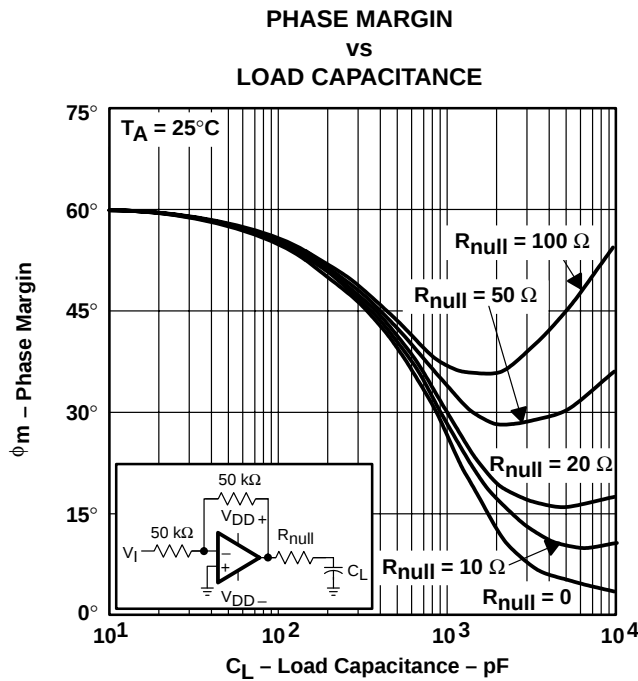
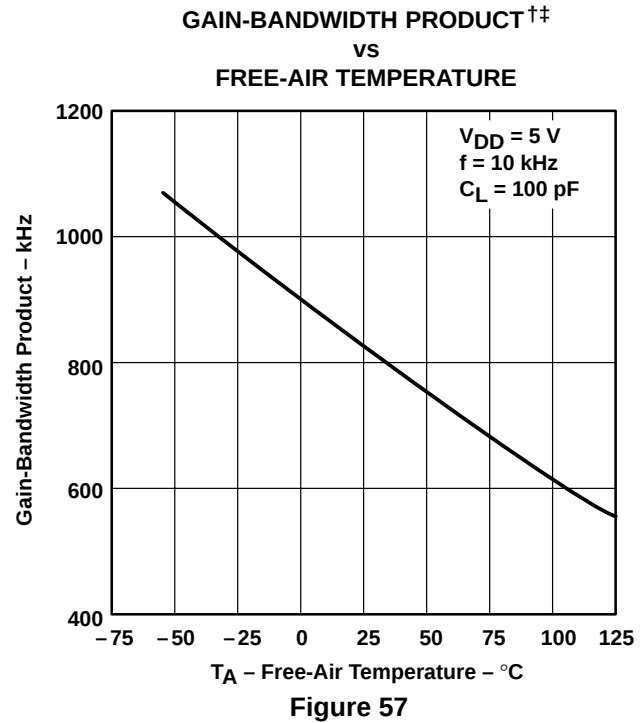
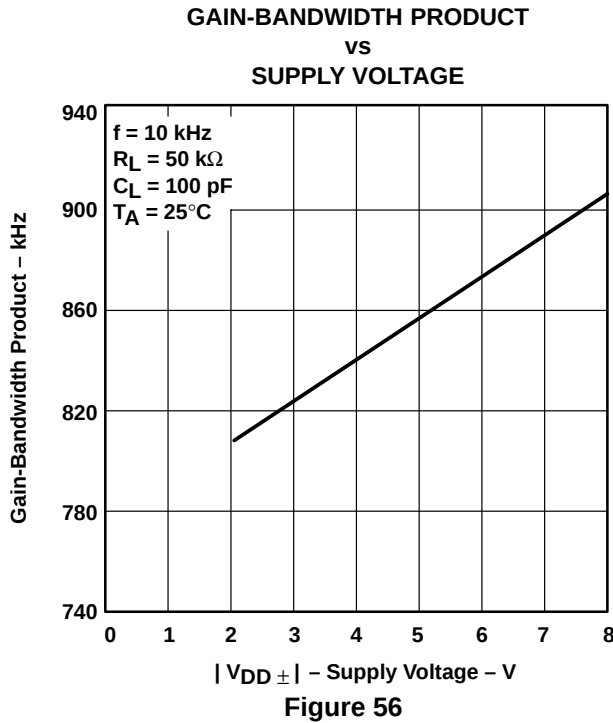


Figure 55

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

TYPICAL CHARACTERISTICS



† 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.

TLC226x, TLC226xA

Advanced LinCMOS™ RAIL-TO-RAIL

OPERATIONAL AMPLIFIERS

SLOS177D – FEBRUARY 1997 – REVISED MARCH 2001

TYPICAL CHARACTERISTICS

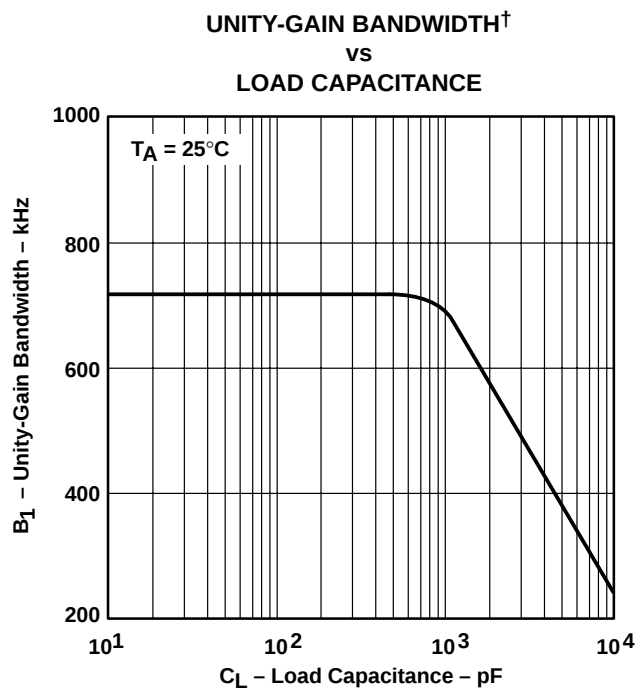


Figure 60



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 58 and Figure 59 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 62) improves the gain and phase margins when driving large capacitive loads. Figure 58 and Figure 59 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.

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

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 60). To use equation 1, UGBW must be approximated from Figure 60.

Using equation 1 alone overestimates the improvement in phase margin, as illustrated in Figure 61. 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.

$$F = \frac{1}{1 + g_m \times R_{null}} \quad (2)$$

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)

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

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 60 and Figure 61 enables the designer to choose the appropriate output series resistance to optimize the design of circuits driving large capacitive loads.

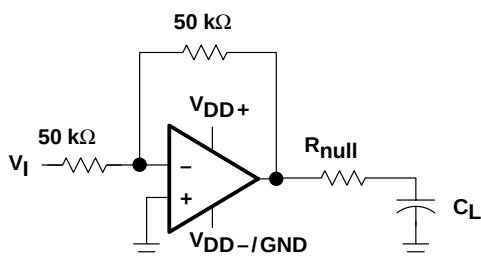


Figure 62. Series-Resistance Circuit

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 63 are generated using the TLC226x typical electrical and operating characteristics at $T_A = 25^\circ\text{C}$. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

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

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

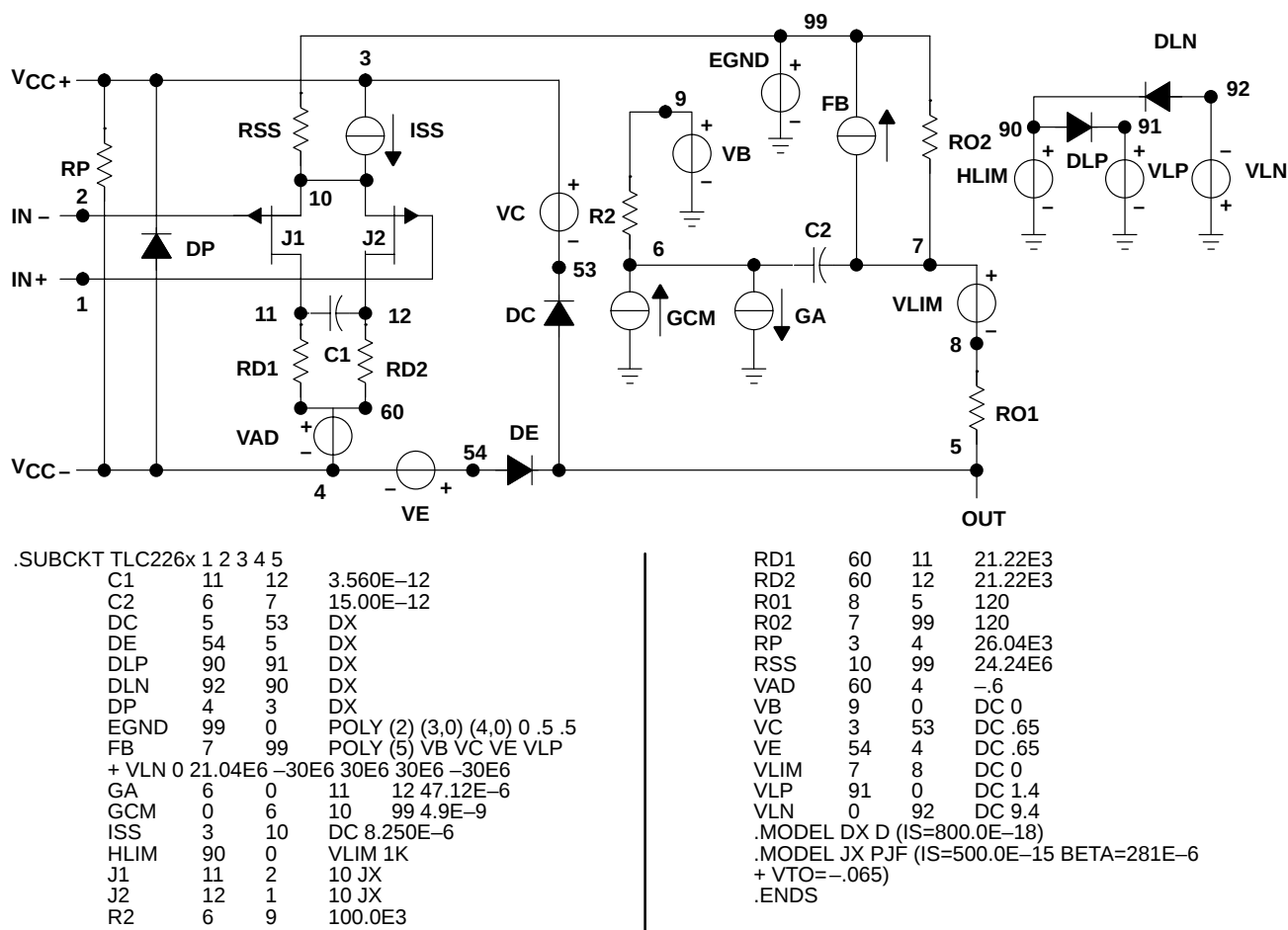


Figure 63. Boyle Macromodel and Subcircuit

PSpice and *Parts* are trademarks of MicroSim Corporation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
5962-9469201QHA	Active	Production	CFP (U) 10	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9469201QHA TLC2262M
5962-9469203QPA	Active	Production	CDIP (JG) 8	50 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9469203QPA TLC2262AM
5962-9469204Q2A	Active	Production	LCCC (FK) 20	55 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9469204Q2A TLC2264 AMFKB
5962-9469204QCA	Active	Production	CDIP (J) 14	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9469204QC A TLC2264AMJB
TLC2262AID	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2262AI
TLC2262AID.A	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2262AI
TLC2262AIDG4	Active	Production	SOIC (D) 8	75 TUBE	-	Call TI	Call TI	-40 to 125	
TLC2262AIDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2262AI
TLC2262AIDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2262AI
TLC2262AIP	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TLC2262AI
TLC2262AIP.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TLC2262AI
TLC2262AIPWR	Active	Production	TSSOP (PW) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y2262A
TLC2262AIPWR.A	Active	Production	TSSOP (PW) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y2262A
TLC2262AIPWRG4	Active	Production	TSSOP (PW) 8	2000 LARGE T&R	-	Call TI	Call TI	-40 to 125	
TLC2262AMJG	Active	Production	CDIP (JG) 8	50 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLC2262 AMJG
TLC2262AMJG.A	Active	Production	CDIP (JG) 8	50 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLC2262 AMJG
TLC2262AMJGB	Active	Production	CDIP (JG) 8	50 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9469203QPA TLC2262AM
TLC2262AMJGB.A	Active	Production	CDIP (JG) 8	50 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9469203QPA TLC2262AM
TLC2262AQD	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-40 to 125	C2262A
TLC2262CD	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	2262C
TLC2262CD.A	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	2262C

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TLC2262CDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	2262C
TLC2262CDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	2262C
TLC2262CP	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC2262CP
TLC2262CP.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC2262CP
TLC2262CPE4	Active	Production	PDIP (P) 8	50 TUBE	-	Call TI	Call TI	0 to 70	
TLC2262CPW	Obsolete	Production	TSSOP (PW) 8	-	-	Call TI	Call TI	0 to 70	P2262
TLC2262CPWR	Active	Production	TSSOP (PW) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	P2262
TLC2262CPWR.A	Active	Production	TSSOP (PW) 8	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	P2262
TLC2262CPWRG4	Active	Production	TSSOP (PW) 8	2000 LARGE T&R	-	Call TI	Call TI	0 to 70	
TLC2262ID	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-	2262I
TLC2262ID.A	Active	Production	SOIC (D) 8	75 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2262I
TLC2262IDG4	Active	Production	SOIC (D) 8	75 TUBE	-	Call TI	Call TI	See TLC2262ID	
TLC2262IDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	2262I
TLC2262IDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2262I
TLC2262IP	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLC2262IP
TLC2262IP.A	Active	Production	PDIP (P) 8	50 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TLC2262IP
TLC2262MUB	Active	Production	CFP (U) 10	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9469201QHA TLC2262M
TLC2262MUB.A	Active	Production	CFP (U) 10	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9469201QHA TLC2262M
TLC2262QD	Obsolete	Production	SOIC (D) 8	-	-	Call TI	Call TI	-40 to 125	C2262Q
TLC2262QDR	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C2262Q
TLC2262QDR.A	Active	Production	SOIC (D) 8	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	C2262Q
TLC2264AID	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AI
TLC2264AID.B	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AI
TLC2264AIDG4	Active	Production	SOIC (D) 14	50 TUBE	-	Call TI	Call TI	-40 to 125	
TLC2264AIDR	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AI
TLC2264AIDR.B	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AI
TLC2264AIN	Active	Production	PDIP (N) 14	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TLC2264AIN
TLC2264AIN.A	Active	Production	PDIP (N) 14	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 125	TLC2264AIN
TLC2264AIPW	Obsolete	Production	TSSOP (PW) 14	-	-	Call TI	Call TI	-40 to 125	Y2264A

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TLC2264AIPWR	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y2264A
TLC2264AIPWR.B	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	Y2264A
TLC2264AIPWRG4	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	-	Call TI	Call TI	-40 to 125	
TLC2264AMFKB	Active	Production	LCCC (FK) 20	55 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9469204Q2A TLC2264 AMFKB
TLC2264AMFKB.A	Active	Production	LCCC (FK) 20	55 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9469204Q2A TLC2264 AMFKB
TLC2264AMJB	Active	Production	CDIP (J) 14	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9469204QC A TLC2264AMJB
TLC2264AMJB.A	Active	Production	CDIP (J) 14	25 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9469204QC A TLC2264AMJB
TLC2264AQD	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AQ
TLC2264AQD.A	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AQ
TLC2264AQD.B	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	2264AQ
TLC2264AQDRG4	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	PJ2264A
TLC2264AQDRG4.A	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PJ2264A
TLC2264AQDRG4.B	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PJ2264A
TLC2264CD	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC2264C
TLC2264CD.B	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC2264C
TLC2264CDR	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC2264C
TLC2264CDR.B	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC2264C
TLC2264CN	Active	Production	PDIP (N) 14	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC2264CN
TLC2264CN.B	Active	Production	PDIP (N) 14	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC2264CN
TLC2264CPW	Obsolete	Production	TSSOP (PW) 14	-	-	Call TI	Call TI	0 to 70	P2264
TLC2264CPWR	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU SN	Level-1-260C-UNLIM	0 to 70	P2264
TLC2264CPWR.B	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	P2264
TLC2264CPWR1G4	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	P2264

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TLC2264ID	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-	TLC2264I
TLC2264ID.B	Active	Production	SOIC (D) 14	50 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC2264I
TLC2264IDR	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	TLC2264I
TLC2264IDR.B	Active	Production	SOIC (D) 14	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLC2264I
TLC2264IN	Active	Production	PDIP (N) 14	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLC2264IN
TLC2264IN.B	Active	Production	PDIP (N) 14	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	TLC2264IN

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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OTHER QUALIFIED VERSIONS OF TLC2262, TLC2262A, TLC2262AM, TLC2262M, TLC2264A, TLC2264AM :

- Catalog : [TLC2262A](#), [TLC2262](#), [TLC2264A](#)
- Automotive : [TLC2264A-Q1](#), [TLC2264A-Q1](#)
- Military : [TLC2262M](#), [TLC2262AM](#), [TLC2264AM](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

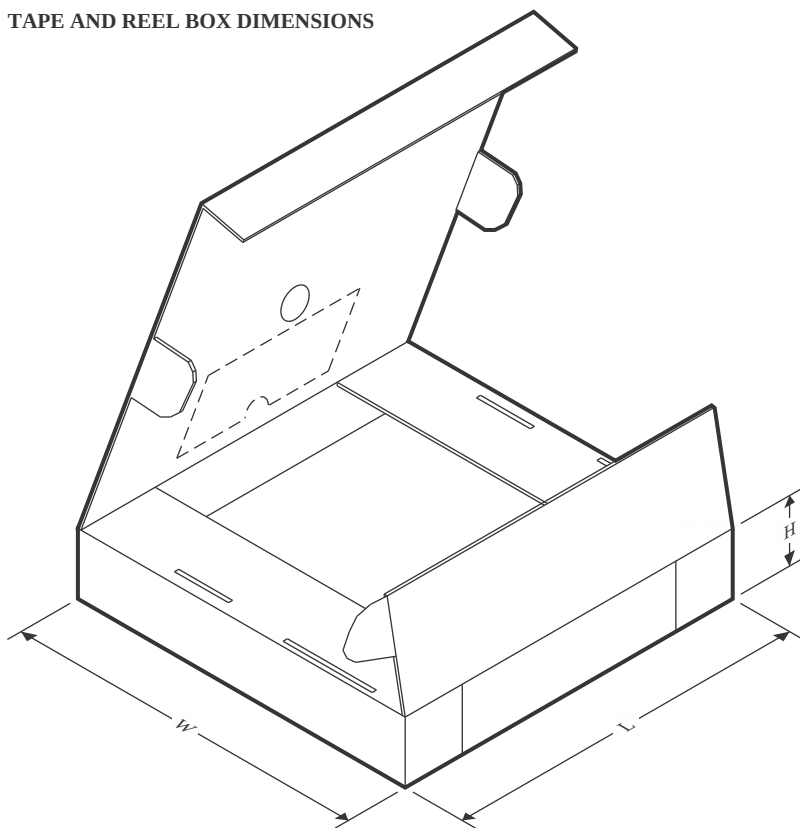
TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLC2262AIDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLC2262AIPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TLC2262CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLC2262CPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TLC2262IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLC2262QDR	SOIC	D	8	2500	330.0	12.5	6.4	5.2	2.1	8.0	12.0	Q1
TLC2264AIDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLC2264AIPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TLC2264AQDRG4	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLC2264CDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
TLC2264CPWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TLC2264CPWR1G4	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TLC2264IDR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

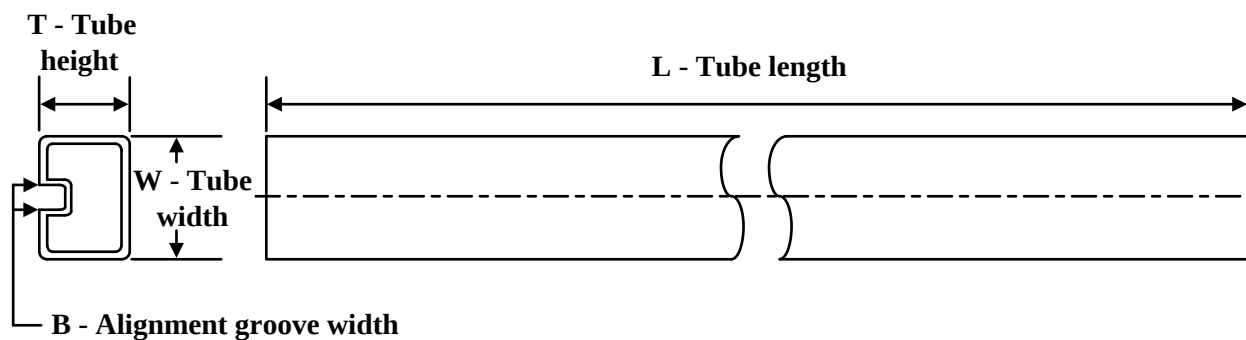
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC2262AIDR	SOIC	D	8	2500	353.0	353.0	32.0
TLC2262AIPWR	TSSOP	PW	8	2000	353.0	353.0	32.0
TLC2262CDR	SOIC	D	8	2500	353.0	353.0	32.0
TLC2262CPWR	TSSOP	PW	8	2000	353.0	353.0	32.0
TLC2262IDR	SOIC	D	8	2500	353.0	353.0	32.0
TLC2262QDR	SOIC	D	8	2500	340.5	338.1	20.6
TLC2264AIDR	SOIC	D	14	2500	340.5	336.1	32.0
TLC2264AIPWR	TSSOP	PW	14	2000	353.0	353.0	32.0
TLC2264AQDRG4	SOIC	D	14	2500	353.0	353.0	32.0
TLC2264CDR	SOIC	D	14	2500	353.0	353.0	32.0
TLC2264CPWR	TSSOP	PW	14	2000	353.0	353.0	32.0
TLC2264CPWR1G4	TSSOP	PW	14	2000	353.0	353.0	32.0
TLC2264IDR	SOIC	D	14	2500	353.0	353.0	32.0

TUBE



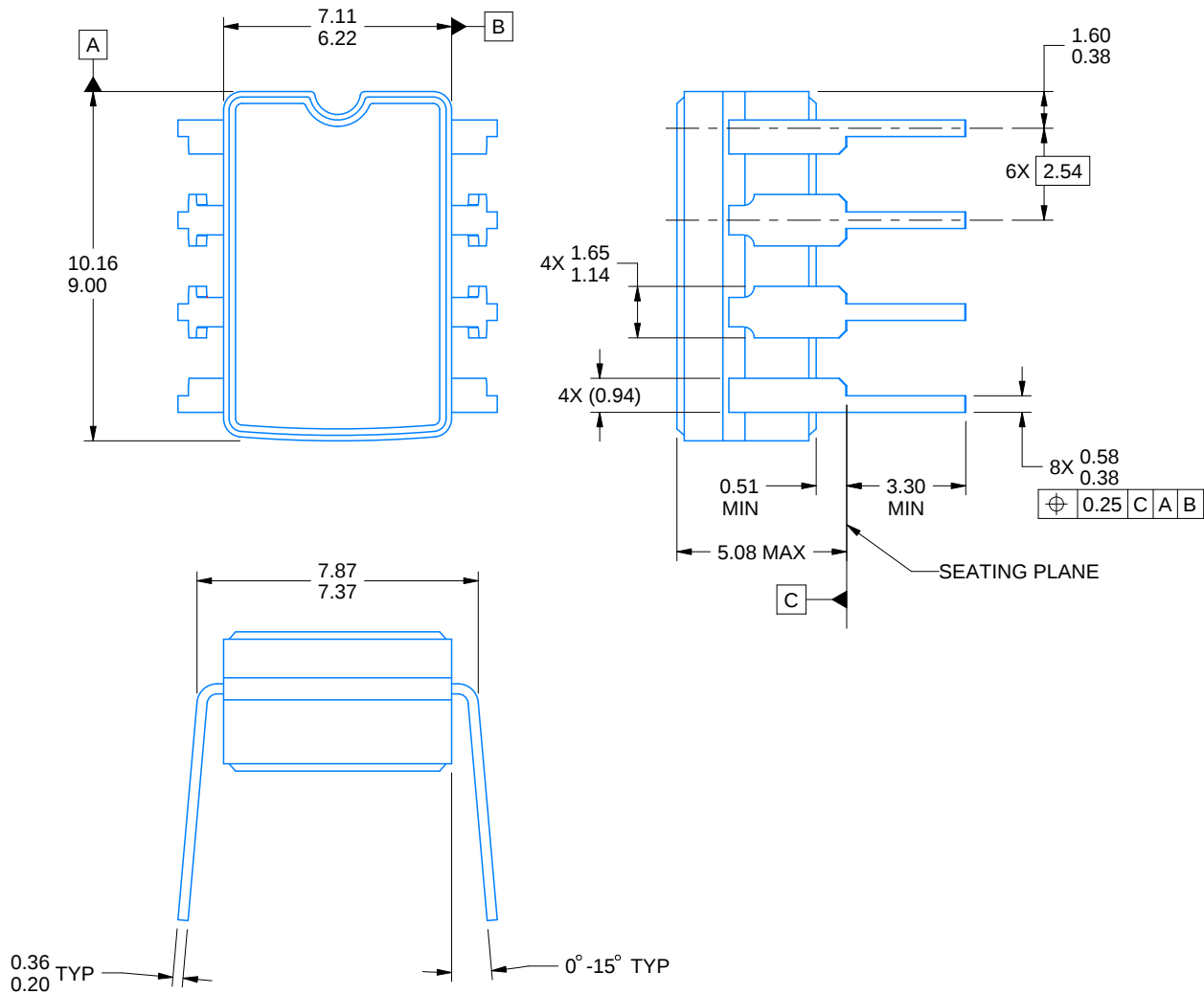
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
5962-9469201QHA	U	CFP	10	25	506.98	26.16	6220	NA
5962-9469204Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
TLC2262AID	D	SOIC	8	75	507	8	3940	4.32
TLC2262AID	D	SOIC	8	75	505.46	6.76	3810	4
TLC2262AID.A	D	SOIC	8	75	505.46	6.76	3810	4
TLC2262AID.A	D	SOIC	8	75	507	8	3940	4.32
TLC2262AIP	P	PDIP	8	50	506	13.97	11230	4.32
TLC2262AIP.A	P	PDIP	8	50	506	13.97	11230	4.32
TLC2262CD	D	SOIC	8	75	507	8	3940	4.32
TLC2262CD.A	D	SOIC	8	75	507	8	3940	4.32
TLC2262CP	P	PDIP	8	50	506	13.97	11230	4.32
TLC2262CP.A	P	PDIP	8	50	506	13.97	11230	4.32
TLC2262ID	D	SOIC	8	75	507	8	3940	4.32
TLC2262ID.A	D	SOIC	8	75	507	8	3940	4.32
TLC2262IP	P	PDIP	8	50	506	13.97	11230	4.32
TLC2262IP.A	P	PDIP	8	50	506	13.97	11230	4.32
TLC2262MUB	U	CFP	10	25	506.98	26.16	6220	NA
TLC2262MUB.A	U	CFP	10	25	506.98	26.16	6220	NA
TLC2264AID	D	SOIC	14	50	507	8	3940	4.32
TLC2264AID	D	SOIC	14	50	505.46	6.76	3810	4
TLC2264AID.B	D	SOIC	14	50	505.46	6.76	3810	4
TLC2264AID.B	D	SOIC	14	50	507	8	3940	4.32
TLC2264AIN	N	PDIP	14	25	506	13.97	11230	4.32
TLC2264AIN.A	N	PDIP	14	25	506	13.97	11230	4.32
TLC2264AMFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLC2264AMFKB.A	FK	LCCC	20	55	506.98	12.06	2030	NA
TLC2264AQD	D	SOIC	14	50	507	8	3940	4.32
TLC2264AQD.A	D	SOIC	14	50	507	8	3940	4.32
TLC2264AQD.B	D	SOIC	14	50	507	8	3940	4.32

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TLC2264CD	D	SOIC	14	50	507	8	3940	4.32
TLC2264CD	D	SOIC	14	50	505.46	6.76	3810	4
TLC2264CD.B	D	SOIC	14	50	507	8	3940	4.32
TLC2264CD.B	D	SOIC	14	50	505.46	6.76	3810	4
TLC2264CN	N	PDIP	14	25	506	13.97	11230	4.32
TLC2264CN.B	N	PDIP	14	25	506	13.97	11230	4.32
TLC2264ID	D	SOIC	14	50	507	8	3940	4.32
TLC2264ID.B	D	SOIC	14	50	507	8	3940	4.32
TLC2264IN	N	PDIP	14	25	506	13.97	11230	4.32
TLC2264IN.B	N	PDIP	14	25	506	13.97	11230	4.32

JG0008A**PACKAGE OUTLINE****CDIP - 5.08 mm max height**

CERAMIC DUAL IN-LINE PACKAGE



4230036/A 09/2023

NOTES:

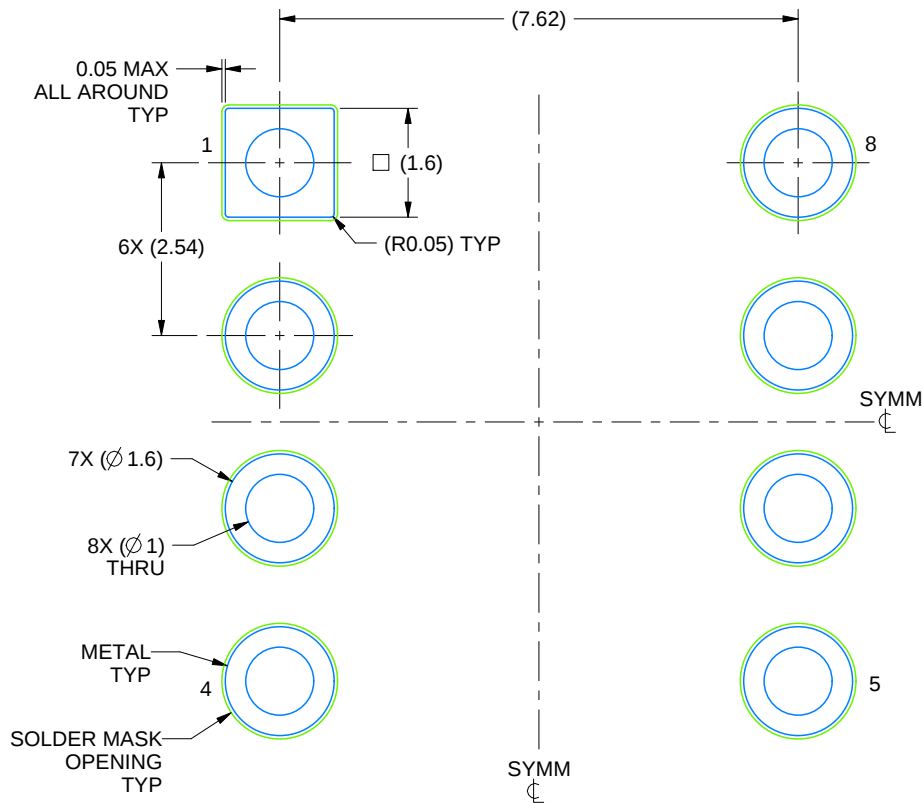
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package can be hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification.
5. Falls within MIL STD 1835 GDIP1-T8

EXAMPLE BOARD LAYOUT

JG0008A

CDIP - 5.08 mm max height

CERAMIC DUAL IN-LINE PACKAGE



LAND PATTERN EXAMPLE
NON SOLDER MASK DEFINED
SCALE: 9X

4230036/A 09/2023

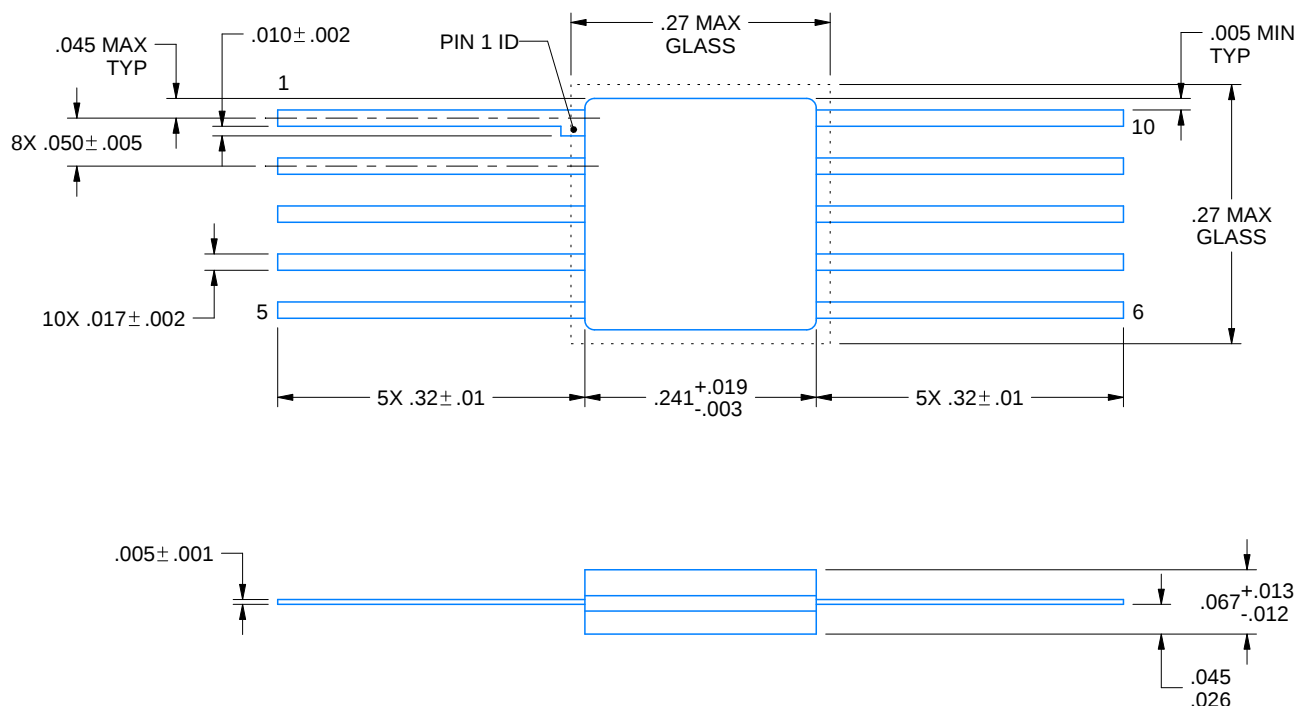
U0010A



PACKAGE OUTLINE

CFP - 2.03 mm max height

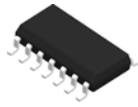
CERAMIC FLATPACK



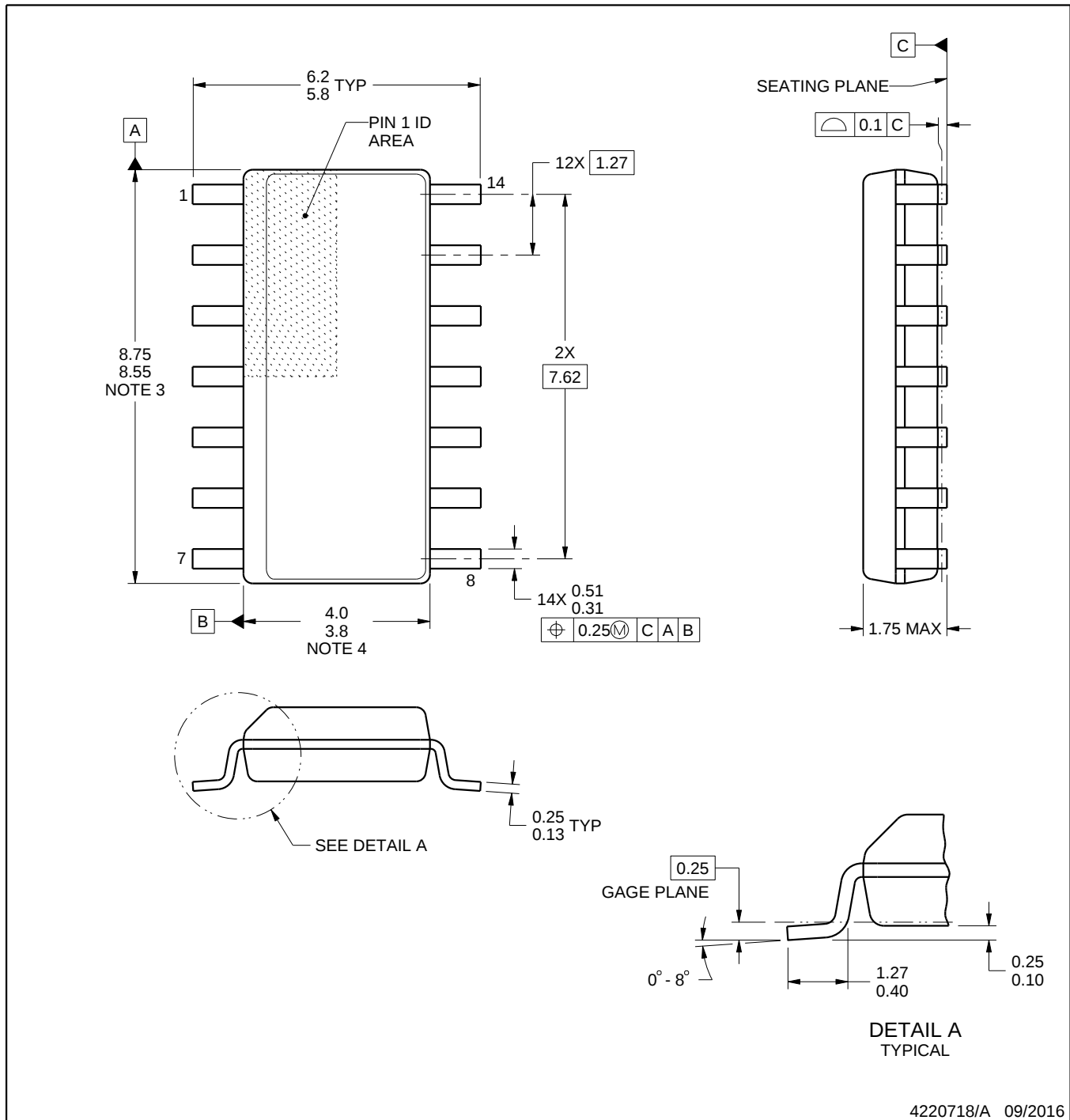
4225582/A 01/2020

NOTES:

1. All linear dimensions are in inches. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

D0014A**PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT

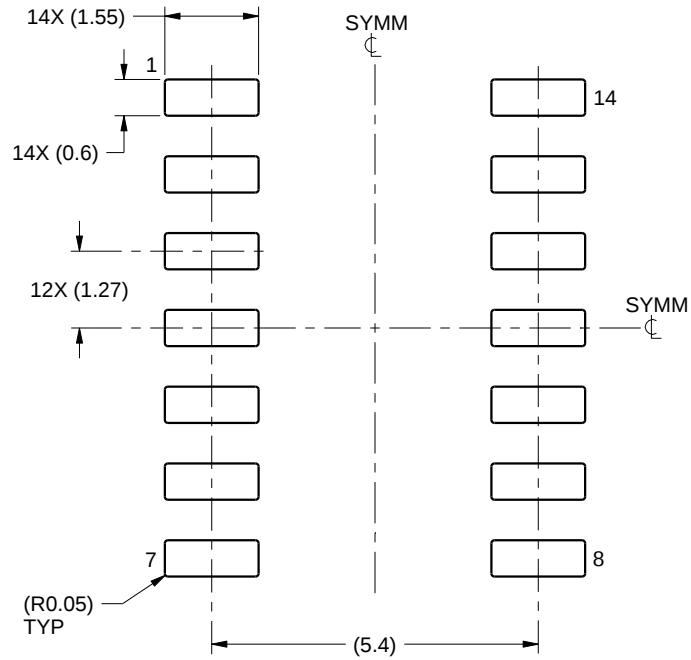


EXAMPLE BOARD LAYOUT

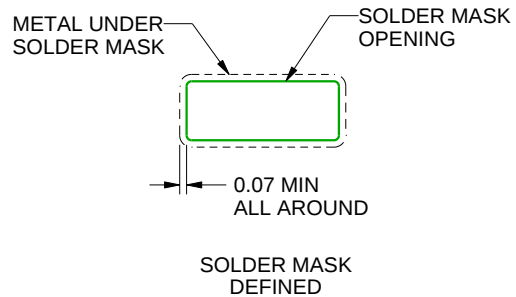
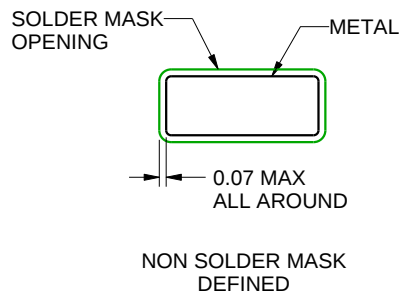
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

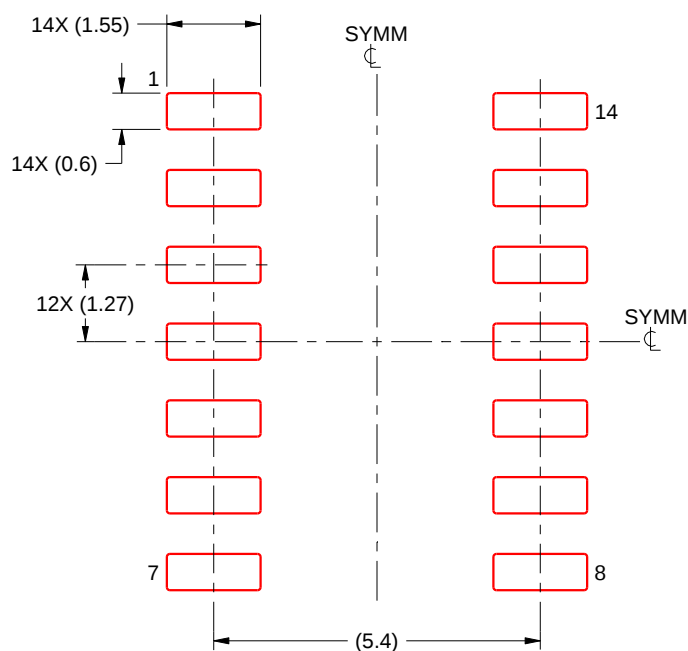
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

GENERIC PACKAGE VIEW

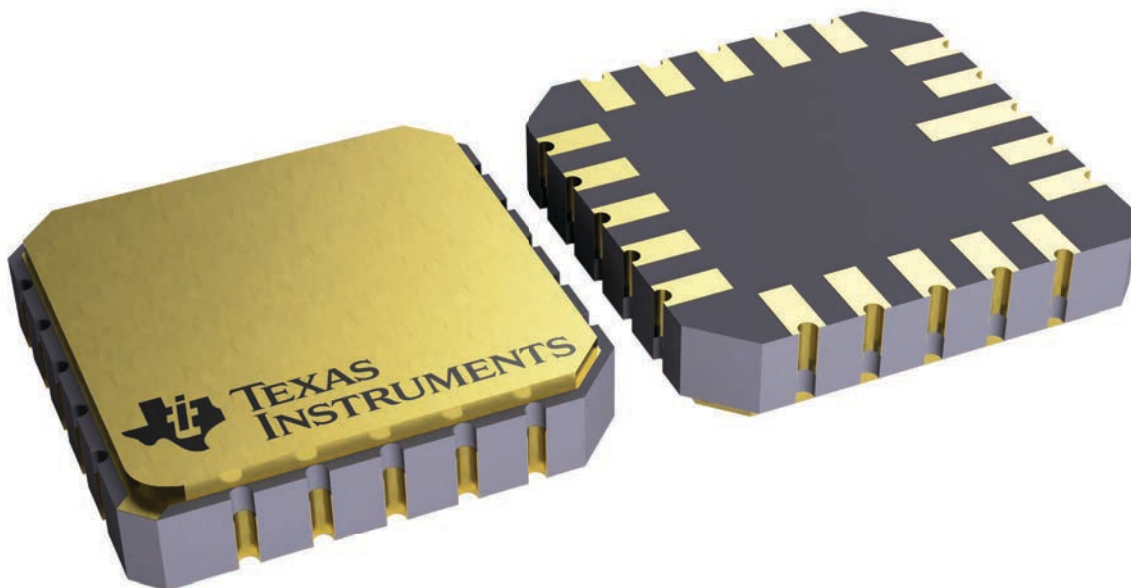
FK 20

LCCC - 2.03 mm max height

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



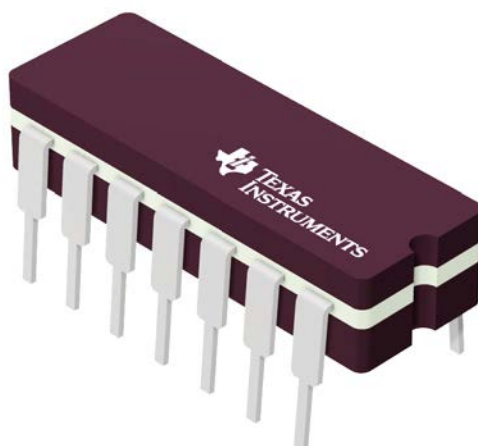
4229370VA\

J 14

GENERIC PACKAGE VIEW

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4040083-5/G

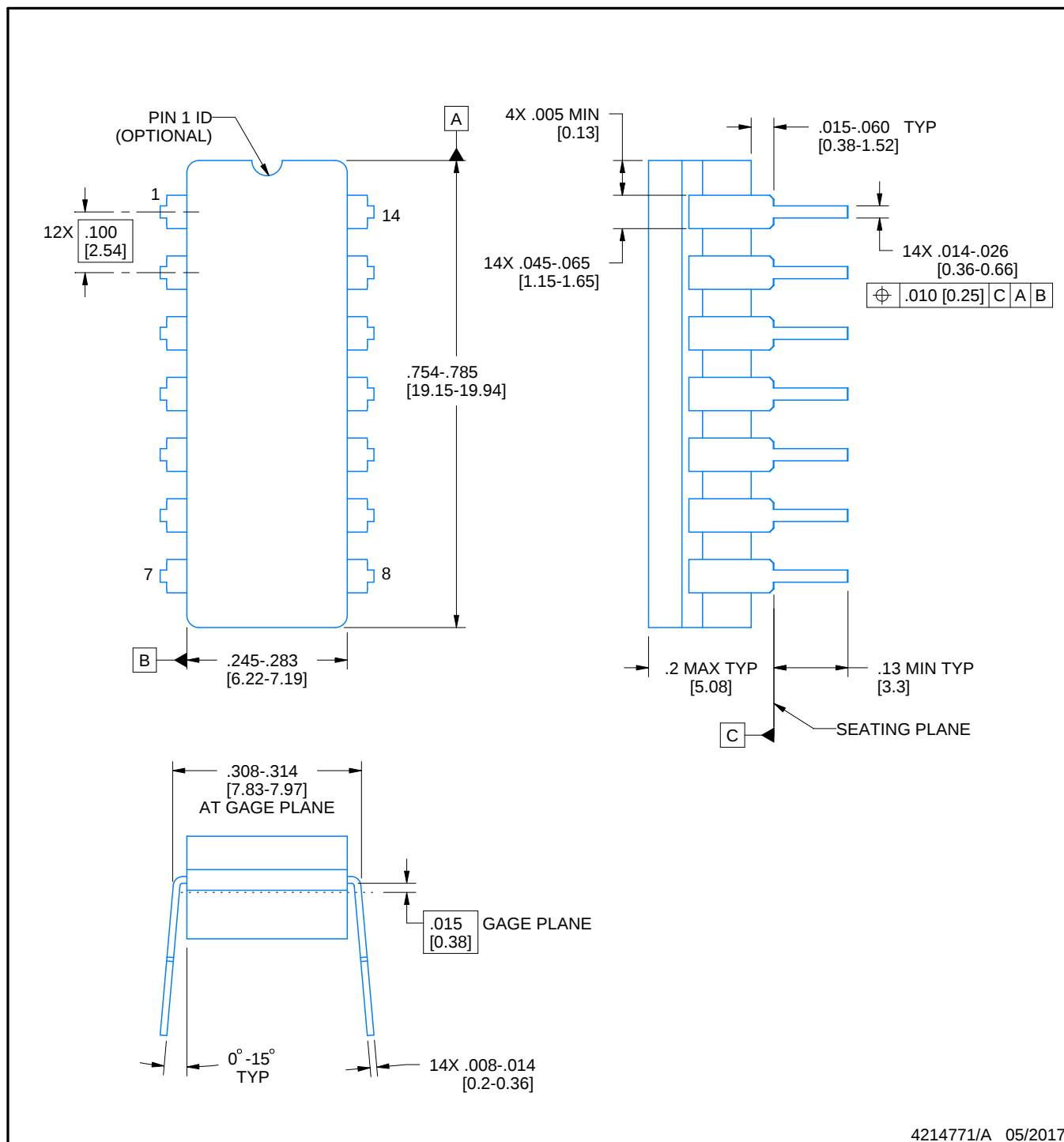


J0014A

PACKAGE OUTLINE

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



NOTES:

1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.



PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

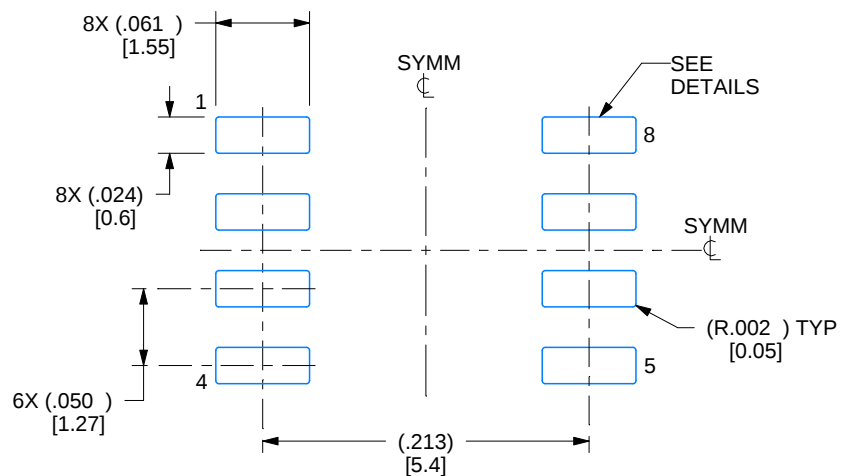


1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.

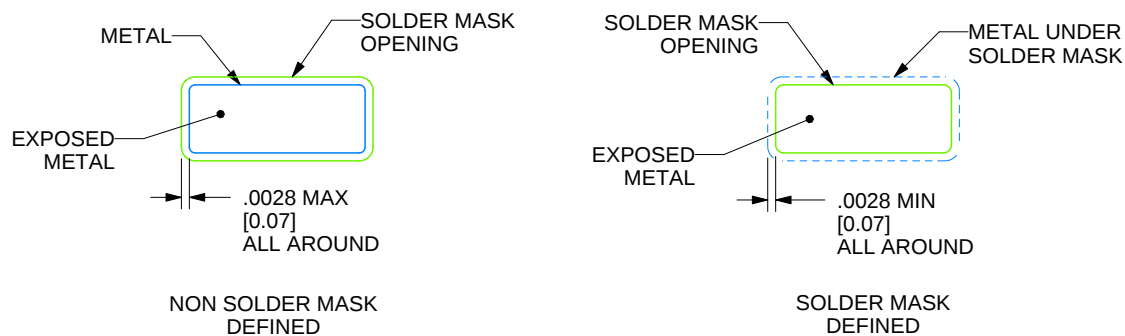
D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

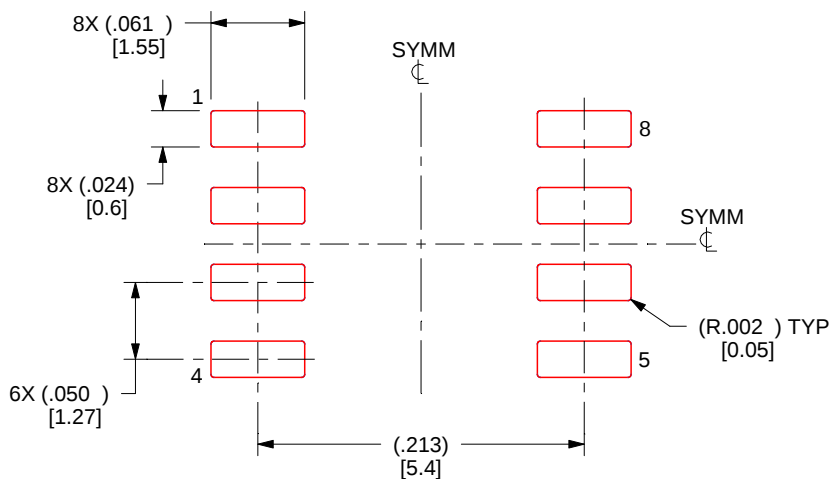
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE

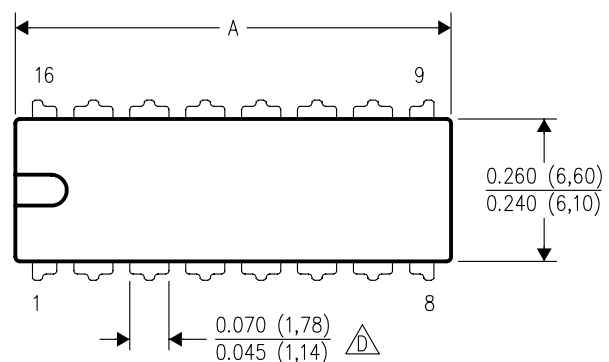


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MS-001 variation BA.

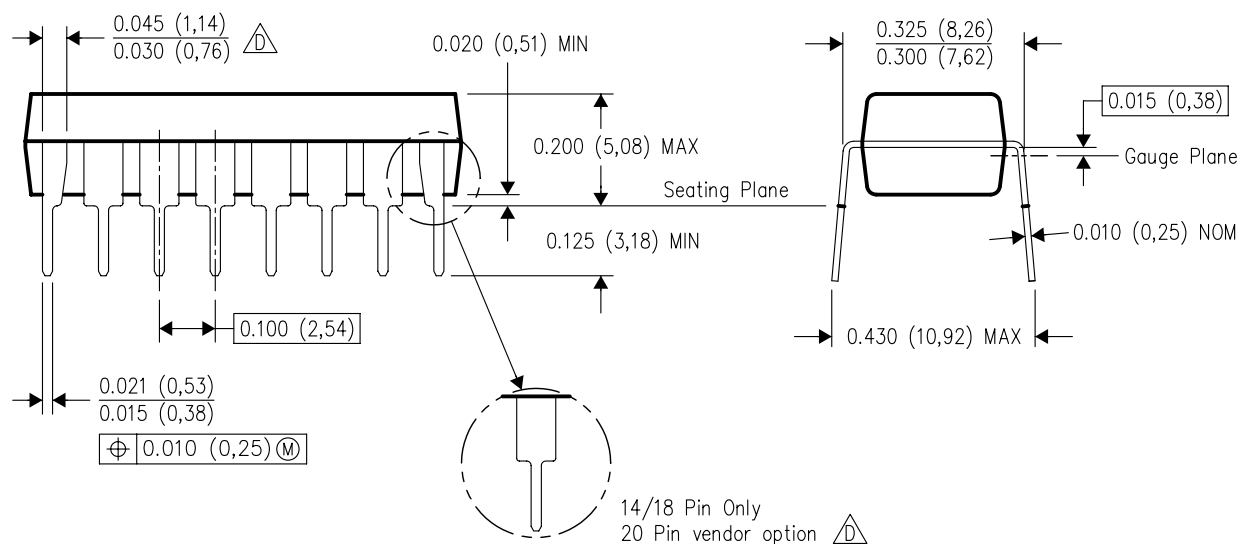
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE

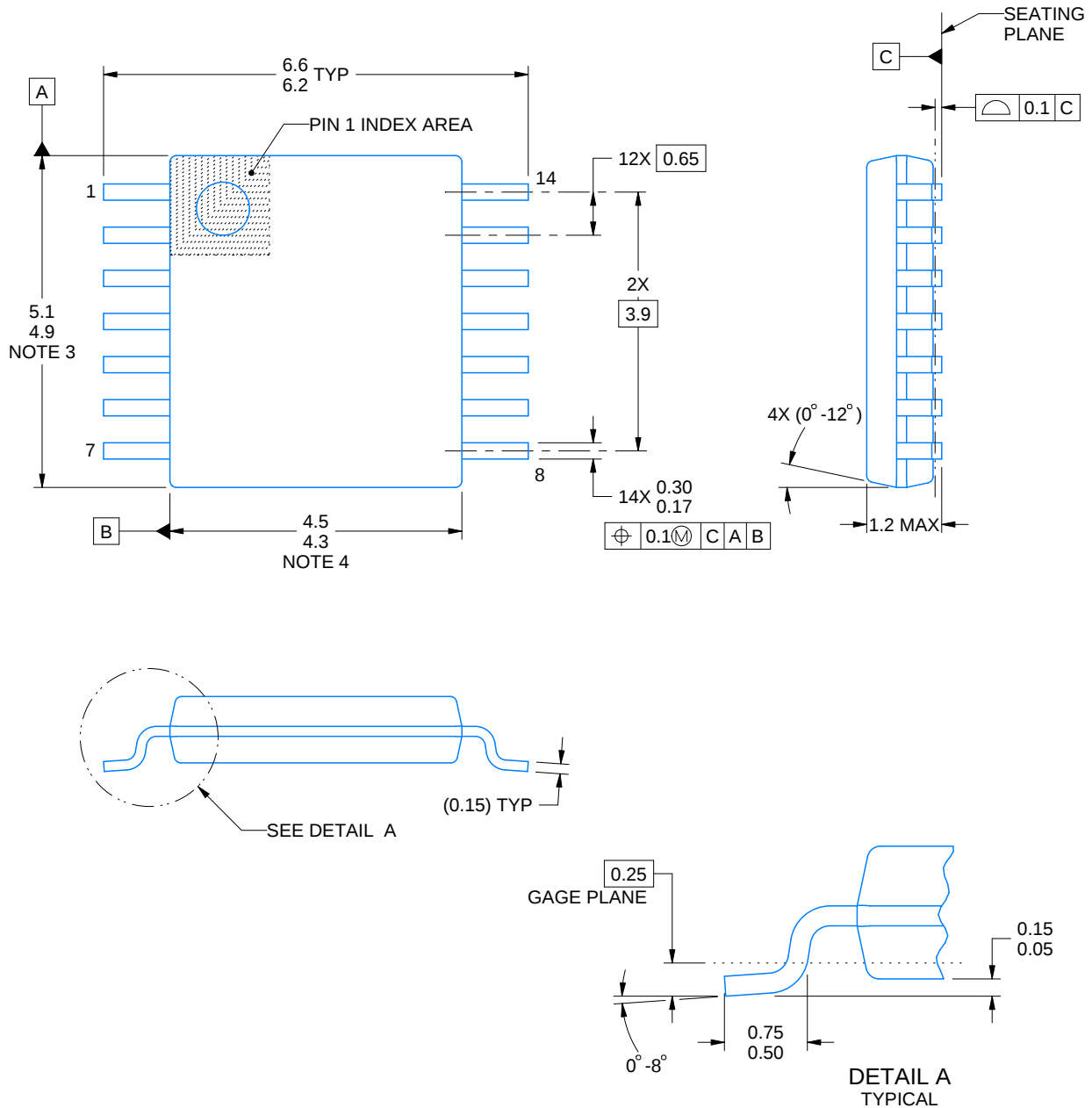
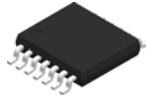


PINS **	14	16	18	20
DIM				
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - D. The 20 pin end lead shoulder width is a vendor option, either half or full width.



4220202/B 12/2023

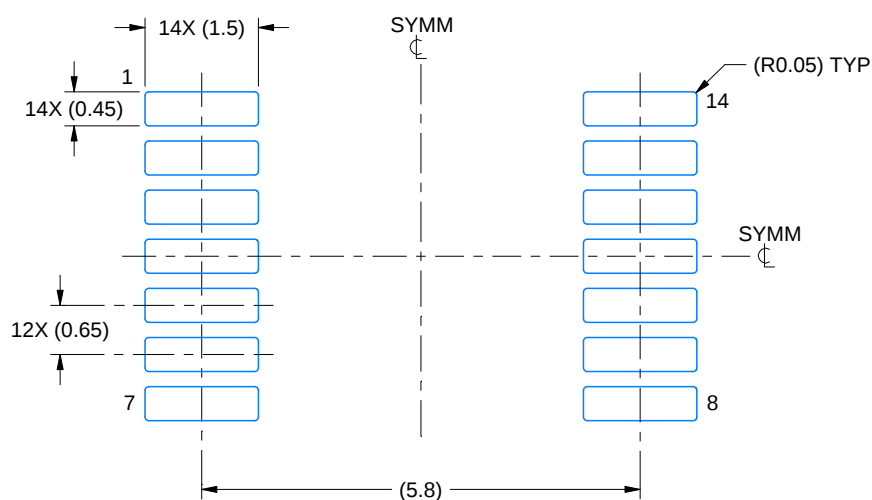
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

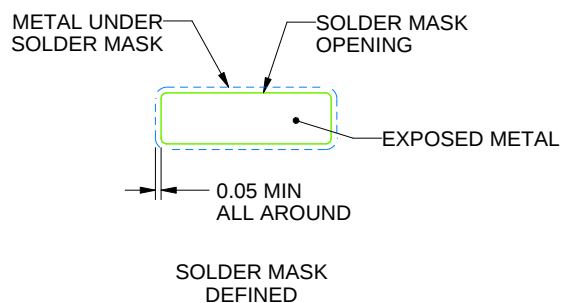
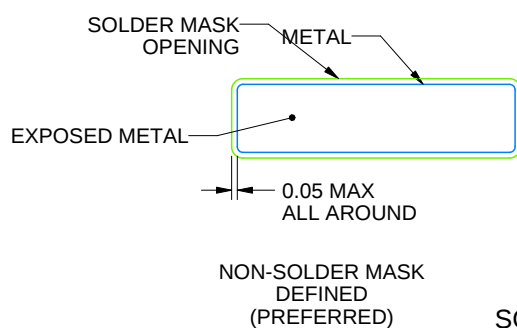
PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220202/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220202/B 12/2023

NOTES: (continued)

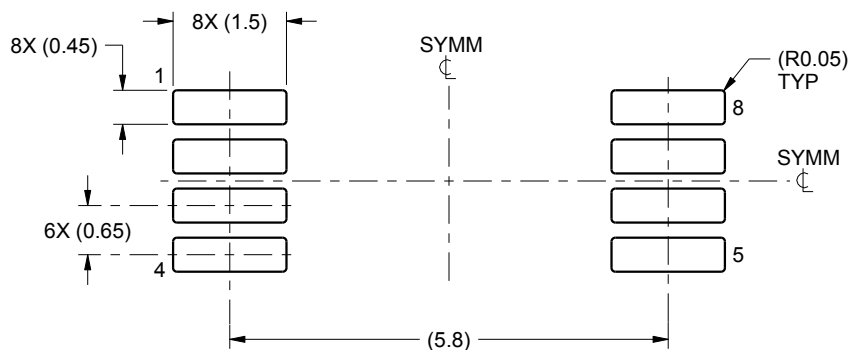
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

EXAMPLE BOARD LAYOUT

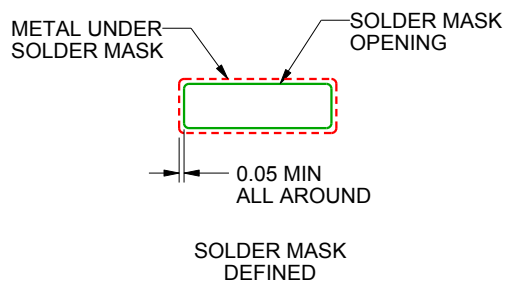
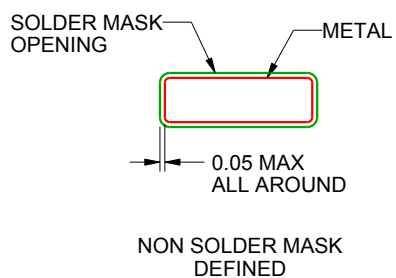
PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:10X



SOLDER MASK DETAILS
NOT TO SCALE

4221848/A 02/2015

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:10X

4221848/A 02/2015

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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