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 Outstanding Combination of dc Precision and AC Performance:

Unity-Gain Bandwidth . . . 15 MHz Typ  $V_n$  . . . . 3.3 nV/ $\sqrt{Hz}$  at f = 10 Hz Typ,

2.5 nV/ $\sqrt{\text{Hz}}$  at f = 1 kHz Typ

 $V_{IO}$  .... 25  $\mu$ V Max

A<sub>VD</sub> ... 45 V/ $\mu$ V Typ With R<sub>L</sub> = 2 kΩ, 19 V/ $\mu$ V Typ With R<sub>I</sub> = 600 Ω

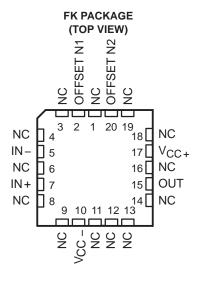
- Available in Standard-Pinout Small-Outline Package
- Output Features Saturation Recovery Circuitry
- Macromodels and Statistical information

### description

The TLE20x7 and TLE20x7A contain innovative circuit design expertise and high-quality process control techniques to produce a level of ac performance and dc precision previously unavailable in single operational amplifiers. Manufactured using Texas Instruments state-of-the-art Excalibur process, these devices allow upgrades to systems that use lower-precision devices.

In the area of dc precision, the TLE20x7 and TLE20x7A offer maximum offset voltages of 100  $\mu$ V and 25  $\mu$ V, respectively, common-mode rejection ratio of 131 dB (typ), supply voltage rejection ratio of 144 dB (typ), and dc gain of 45 V/ $\mu$ V (typ).

#### 



#### **AVAILABLE OPTIONS**

			PACKAGED	DEVICES		
ТA	V <sub>IO</sub> max AT 25°C	SMALL OUTLINE† (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CHIP FORM <sup>‡</sup> (Y)
0°C to 70°C	25 μV	TLE2027ACD TLE2037ACD			TLE2027ACP TLE2037ACP	TLE2027Y TLE2037Y
0 6 to 70 6	100 μV	TLE2027CD TLE2037CD	_ _		TLE2027CP TLE2037CP	TLE2027Y TLE2037Y
-40°C to 105°C	25 μV	TLE2027AID TLE2037AID			TLE2027AIP TLE2037AIP	_
-40 C to 105 C	100 μV	TLE2027ID TLE2037ID			TLE2027IP TLE2037IP	_
–55°C to 125°C	25 μV	TLE2027AMD TLE2037AMD	TLE2027AMFK TLE2037AMFK	TLE2027AMJG TLE2037AMJG	TLE2027AMP TLE2037AMP	_
-95 C to 125 C	100 μV	TLE2027MD TLE2037MD	TLE2027MFK TLE2037MFK	TLE2027MJG TLE2037MJG	TLE2027MP TLE2037MP	_

<sup>†</sup> The D packages are available taped and reeled. Add R suffix to device type (e.g., TLE2027ACDR).

<sup>‡</sup> Chip forms are tested at 25°C only.



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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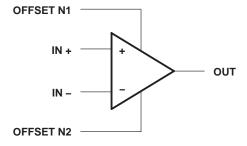
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### description (continued)

The ac performance of the TLE2027 and TLE2037 is highlighted by a typical unity-gain bandwidth specification of 15 MHz,  $55^{\circ}$  of phase margin, and noise voltage specifications of  $3.3 \text{ nV}/\sqrt{\text{Hz}}$  and  $2.5 \text{ nV}/\sqrt{\text{Hz}}$  at frequencies of 10 Hz and 1 kHz respectively. The TLE2037 and TLE2037A have been decompensated for faster slew rate (-7.5 V/µs, typical) and wider bandwidth (50 MHz). To ensure stability, the TLE2037 and TLE2037A should be operated with a closed-loop gain of 5 or greater.

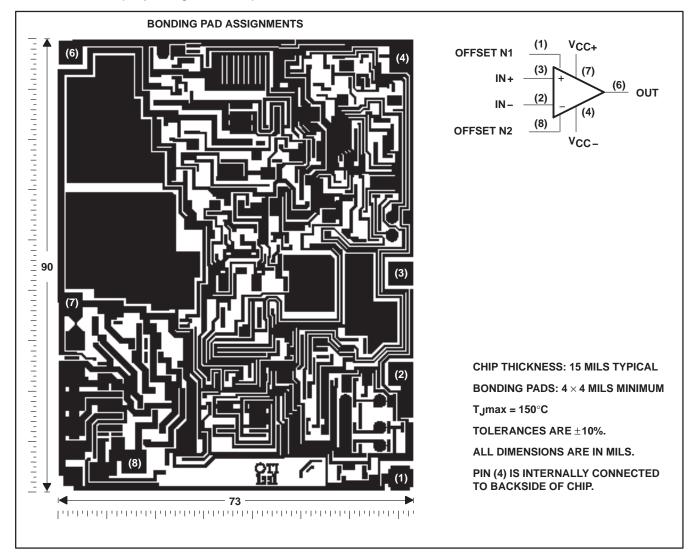
Both the TLE20x7 and TLE20x7A are available in a wide variety of packages, including the industry-standard 8-pin small-outline version for high-density system applications. The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from -40°C to 105°C. The M-suffix devices are characterized for operation over the full military temperature range of -55°C to 125°C.

### symbol

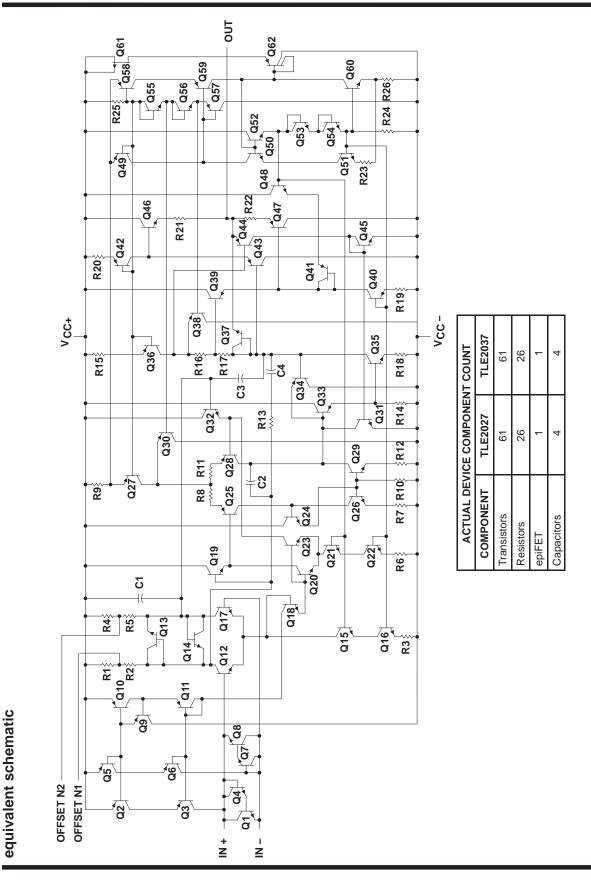


### **TLE202xY** chip information

This chip, when properly assembled, displays characteristics similar to the TLE202xC. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. The chip may be mounted with conductive epoxy or a gold-silicon preform.



### TLE2027, TLE2037, TLE2027A, TLE2037A, TLE2027Y, TLE2037Y EXCALIBUR LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS SLOS192B - FEBRUARY 1997 - REVISED OCTOBER 2006



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

Supply voltage, V <sub>CC+</sub> (see Note 1	)	19 V
		– 19 V
Differential input voltage, VID (see	Note 2)	±1.2 V
Input voltage range, V <sub>I</sub> (any input)	)	V <sub>CC±</sub>
Input current, I <sub>I</sub> (each Input)		±1 mĀ
Output current, IO		± 50 mA
		50 mA
Total current out of V <sub>CC</sub>		50 mA
		unlimited
Continuous total power dissipation	າ	See Dissipation Rating Table
		0°C to 70°C
	I suffix	– 40°C to 105°C
	M suffix	– 55°C to 125°C
Storage temperature range, T <sub>sta</sub>		– 65°C to 150°C
		260°C
Lead temperature 1,6 mm (1/16 ir	nch) from case for 10 seconds:	D or P package 260°C
Lead temperature 1,6 mm (1/16 ir	nch) from case for 60 seconds:	JG package 300°C

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

NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between V<sub>CC+</sub> and V<sub>CC-</sub>.

- 2. Differential voltages are at IN+ with respect to IN –. Excessive current flows if a differential input voltage in excess of approximately ±1.2 V is applied between the inputs unless some limiting resistance is used.
- 3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

#### **DISSIPATION RATING TABLE**

PACKAGE	$T_{\mbox{\scriptsize A}} \le 25^{\circ}\mbox{\scriptsize C}$ POWER RATING	DERATING FACTOR ABOVE T <sub>A</sub> = 25°C	T <sub>A</sub> = 70°C POWER RATING	T <sub>A</sub> = 105°C POWER RATING	T <sub>A</sub> = 125°C POWER RATING
D	725 mW	5.8 mW/°C	464 mW	261 mW	145 mW
FK	1375 mW	11.0 mW/°C	880 mW	495 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	378 mW	210 mW
Р	1000 mW	8.0 mW/°C	640 mW	360 mW	200 mW

### recommended operating conditions

		C SUF	FIX	I SUF	FIX	M SUF	FIX	
		MIN	MAX	MIN	MAX	MIN	MAX	UNIT
Supply voltage, V <sub>CC±</sub>		±4	± 19	±4	±19	±4	±19	V
	T <sub>A</sub> = 25°C	-11	11	-11	11	-11	11	.,
Common-mode input voltage, V <sub>IC</sub>	T <sub>A</sub> = Full range‡	-10.5	10.5	-10.4	10.4	-10.2	10.2	V
Operating free-air temperature, TA		0	70	-40	105	-55	125	°C

<sup>‡</sup> Full range is 0°C to 70°C for C-suffix devices, -40°C to 105°C for I-suffix devices, and -55°C to 125°C for M-suffix devices.



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### TLE20x7C electrical characteristics at specified free-air temperature, $V_{CC^\pm}$ = $\pm 15$ V (unless otherwise noted)

				Т	LE20x70	3	TL	.E20x7A	С	
	PARAMETER	TEST CONDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V	Law of affect well-		25°C		20	100		10	25	
VIO	Input offset voltage		Full range			145			70	μV
$\alpha_{\text{VIO}}$	Temperature coefficient of input offset voltage		Full range		0.4	1		0.2	1	μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$ , $R_S = 50 \Omega$	25°C		0.006	1		0.006	1	μV/mo
lio	Input offset current		25°C		6	90		6	90	nA
lio	input onset current		Full range			150			150	ПА
I <sub>IB</sub>	Input bias current		25°C		15	90		15	90	nA
IIB	input bias current		Full range			150			150	ПА
Vion	Common-mode input	Bo - 50 O	25°C	–11 to 11	-13 to 13		–11 to 11	-13 to 13		V
VICR	voltage range	R <sub>S</sub> = 50 Ω	Full range	-10.5 to 10.5			-10.5 to 10.5			V
		<b>D</b> 000 0	25°C	10.5	12.9		10.5	12.9		
.,	Maximum positive peak	$R_L = 600 \Omega$	Full range	10			10			.,
VOM +	output voltage swing	<b>B</b> 810	25°C	12	13.2		12	13.2		V
		$R_L = 2 k\Omega$	Full range	11			11			
		B 000 0	25°C	-10.5	-13		-10.5	-13		
.,	Maximum negative peak	$R_L = 600 \Omega$	Full range	-10			-10			.,
VOM -	output voltage swing	2.0	25°C	- 12	-13.5		- 12	-13.5		V
		$R_L = 2 k\Omega$	Full range	- 11			- 11			
		$V_O = \pm 11 \text{ V},  R_L = 2 \text{ k}\Omega$	25°C	5	45		10	45		
		$V_O = \pm 10 \text{ V},  R_L = 2 \text{ k}\Omega$	Full range	2			4			
١.	Large-signal differential	V 140V B 410	25°C	3.5	38		8	38		.,,,,,
A <sub>VD</sub>	voltage amplification	$V_O = \pm 10 \text{ V},  R_L = 1 \text{ k}\Omega$	Full range	1			2.5			V/μV
		$V_{O} = \pm 10 \text{ V},$	25°C	2	19		5	19		
		$R_L = 600 \Omega$	Full range	0.5			2			
Ci	Input capacitance		25°C		8			8		pF
z <sub>0</sub>	Open-loop output impedance	IO = 0	25°C		50			50		Ω
01455	Common-mode rejection	V <sub>IC</sub> = V <sub>ICR</sub> min,	25°C	100	131		117	131		.IC
CMRR	ratio	$R_S = 50 \Omega$	Full range	98			114			dB
kovp	Supply-voltage rejection	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ $R_S = 50 \Omega$	25°C	94	144		110	144		dB
kSVR	ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ $R_S = 50 \Omega$	Full range	92			106		_	uБ
loc	Supply current	$V_O = 0$ , No load	25°C		3.8	5.3		3.8	5.3	mA
Icc	Supply current	VO = 0, NO load	Full range			5.6			5.6	111/1

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



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

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### TLE20x7C operating characteristics at specified free-air temperature, $V_{CC\,\pm}$ = $\pm 15$ V, $T_A$ = $25^{\circ}C$ (unless otherwise specified)

					TLE20x7C			TLE20x7AC		
	PARAMETER	TEST CONDI	TIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
		$R_L = 2 k\Omega$ ,	TLE2027	1.7	2.8		1.7	2.8		
		C <sub>L</sub> = 100 pF, See Figure 1	TLE2037	6	7.5		6	7.5		
SR	Slew rate at unity gain	$R_L = 2 k\Omega$ , $C_L = 100 pF$ ,	TLE2027	1.2			1.2			V/μs
		$T_A = 0$ °C to 70°C, See Figure 1	TLE2037	5			5			
,	Equivalent input noise volt-	$R_S = 20 \Omega$ ,	f = 10 Hz		3.3	8		3.3	4.5	nV/√ <del>Hz</del>
V <sub>n</sub>	age (see Figure 2)	$R_S = 20 \Omega$ ,	f = 1 kHz		2.5	4.5		2.5	3.8	IIV/∀⊓Z
V <sub>N(PP)</sub>	Peak-to-peak equivalent in- put noise voltage	f = 0.1 Hz to 10 Hz			50	250		50	130	nV
	Equivalent input noise cur-	f = 10 Hz			10	25		10	25	0.4/1.
<sup>I</sup> n	rent	f = 1 kHz			0.8	1.8		0.8	1.8	pA/√Hz
T. 15	Total beautiful distriction	$V_O = +10 \text{ V},$ $A_{VD} = 1,$ See Note 5	TLE2027		<0.002%			<0.002%		
THD	Total harmonic distortion	$V_O = +10 \text{ V},$ $A_{VD} = 5,$ See Note 5	TLE2037		<0.002%			<0.002%		
B <sub>1</sub>	Unity-gain bandwidth (see Figure 3)	$R_L = 2 k\Omega$ , $C_L = 100 pF$	TLE2027	9(6)	13		9(6)	13		NALL-
GBW	Gain bandwidth product	$R_L = 2 k\Omega$ , $C_L = 100 pF$	TLE2037	35	50		35	50		MHz
_	Maximum output-swing	D 010	TLE2027		30			30		1-11-
ВОМ	bandwidth	$R_L = 2 k\Omega$	TLE2037		80			80		kHz
φ.	Phase margin at unity gain	R <sub>L</sub> = 2 kΩ,	TLE2027		55°			55°		
Φm	(see Figure 3)	C <sub>L</sub> = 100 pF	TLE2037		50°			50°		

NOTE 5: Measured distortion of the source used in the analysis was 0.002%.

NOTE 6: This parameter is not production tested



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### TLE20x7I electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = $\pm 15$ V (unless otherwise noted)

		TEOT 001151110110	_ +	Т	LE20x7		TI	_E20x7A	ı	
	PARAMETER	TEST CONDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
.,	land offering		25°C		20	100		10	25	V
VIO	Input offset voltage		Full range			180			105	μV
$\alpha_{\text{VIO}}$	Temperature coefficient of input offset voltage		Full range		0.4	1		0.2	1	μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$ , $R_S = 50 \Omega$	25°C		0.006	1		0.006	1	μV/mo
l.o	Input offset current		25°C		6	90		6	90	nΛ
IIO	input onset current		Full range			150			150	nA
lın	Input bias current		25°C		15	90		15	90	nA
IIB	input bias current		Full range			150			150	IIA
\/	Common-mode input	D- 50 0	25°C	–11 to 11	-13 to 13		–11 to 11	-13 to 13		V
VICR	voltage range	R <sub>S</sub> = 50 Ω	Full range	-10.4 to 10.4			-10.4 to 10.4			V
		<b>D</b> 200 C	25°C	10.5	12.9		10.5	12.9		
.,	Maximum positive peak	$R_L = 600 \Omega$	Full range	10			10			.,
VOM +	output voltage swing	D 01-0	25°C	12	13.2		12	13.2		V
		$R_L = 2 k\Omega$	Full range	11			11			
		D. 600 O	25°C	-10.5	-13		-10.5	-13		
\/	Maximum negative peak	R <sub>L</sub> = 600 Ω	Full range	-10			-10			.,
VOM -	output voltage swing	D. Alio	25°C	- 12	-13.5		- 12	-13.5		V
		$R_L = 2 k\Omega$	Full range	- 11			- 11			
		$V_O = \pm 11 \text{ V}, R_L = 2 \text{ k}\Omega$	25°C	5	45		10	45		
		$V_O = \pm 10 \text{ V}, \text{ R}_L = 2 \text{ k}\Omega$	Full range	2			3.5			
	Large-signal differential	V 140 V D 410	25°C	3.5	38		8	38		.,, .,
$A_{VD}$	voltage amplification	$V_O = \pm 10 \text{ V}, R_L = 1 \text{ k}\Omega$	Full range	1			2.2			V/µV
		V .40 V D .000 O	25°C	2	19		5	19		
		$V_0 = \pm 10 \text{ V}, R_L = 600 \Omega$	Full range	0.5			1.1			
Ci	Input capacitance		25°C		8			8		pF
z <sub>0</sub>	Open-loop output impedance	I <sub>O</sub> = 0	25°C		50			50		Ω
01455	Common-mode rejection	V <sub>IC</sub> = V <sub>ICR</sub> min,	25°C	100	131		117	131		
CMRR	ratio	$R_S = 50 \Omega$	Full range	96			113			dB
kov-	Supply-voltage rejection	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ $R_S = 50 \Omega$	25°C	94	144		110	144		40
ksvr	ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ $R_S = 50 \Omega$	Full range	90			105			dB
loo	Supply current	$V_{O} = 0$ , No load	25°C		3.8	5.3		3.8	5.3	mA
ICC	Supply current	$V_O = 0$ , No load	Full range			5.6			5.6	mA

<sup>†</sup>Full range is – 40°C to 105°C.



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

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### TLE20x7I operating characteristics at specified free-air temperature, V<sub>CC</sub> $_{\pm}$ = $\pm 15$ V, T<sub>A</sub> = 25°C (unless otherwise specified)

	DARAMETER	TEST SOME	10110		TLE20x7I			TLE20x7AI		
	PARAMETER	TEST CONDIT	IONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
		$R_L = 2 k\Omega$ ,	TLE2027	1.7	2.8		1.7	2.8		
		C <sub>L</sub> = 100 pF, See Figure 1	TLE2037	6	7.5		6	7.5		
SR	Slew rate at unity gain	$R_L = 2 k\Omega$ , $C_L = 100 pF$ ,	TLE2027	1.1			1.1			V/μs
		$T_A = -40^{\circ}C$ to $85^{\circ}C$ , See Figure 1	TLE2037	4.7			4.7			
V	Equivalent input noise	$R_S = 20 \Omega$ ,	f = 10 Hz		3.3	8		3.3	4.5	nV/√ <del>Hz</del>
V <sub>n</sub>	voltage (see Figure 2)	$R_S = 20 \Omega$ ,	f = 1 kHz		2.5	4.5		2.5	3.8	IIV/VIIZ
V <sub>N(PP)</sub>	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 10 Hz			50	250		50	130	nV
	Equivalent input noise	f = 10 Hz			10	25		10	25	A / /II
<sup>I</sup> n	current	f = 1 kHz			0.8	1,8		0.8	1.8	pA/√Hz
		V <sub>O</sub> = +10 V, A <sub>VD</sub> = 1, See Note 5	TLE2027		< 0.002%			< 0.002%		
THD	Total harmonic distortion	V <sub>O</sub> = +10 V, A <sub>VD</sub> = 5, See Note 5	TLE2037		< 0.002%			< 0.002%		
B <sub>1</sub>	Unity-gain bandwidth (see Figure 3)	$R_L = 2 k\Omega$ , $C_L = 100 pF$	TLE2027	9(6)	13		9(6)	13		MHz
GBW	Gain bandwidth product	$R_L = 2 k\Omega$ , $C_L = 100 pF$	TLE2037	35	50		35	50		IVIMZ
Б	Maximum output-swing	D 01-0	TLE2027		30			30		1-11-
B <sub>OM</sub>	bandwidth	$R_L = 2 k\Omega$	TLE2037		80			80		kHz
4	Phase margin at unity	$R_L = 2 k\Omega$ ,	TLE2027		55°			55°		
Φm	gain (see Figure 3)	$C_{L} = 100 \text{ pF}$	TLE2037		50°			50°		

NOTE 5: Measured distortion of the source used in the analysis was 0.002%.

NOTE 6: This parameter is not production tested.



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### TLE20x7M electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = $\pm 15$ V (unless otherwise noted)

				TI	LE20x7N	И	TL	.E20x7Al	VI	
	PARAMETER	TEST CONDITIONS	T <sub>A</sub> †	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V/10	Input offeet voltage		25°C		20	100		10	25	μV
VIO	Input offset voltage		Full range			200			105	μν
$\alpha_{\text{VIO}}$	Temperature coefficient of input offset voltage		Full range		0.4	1*		0.2	1*	μV/°C
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$ , $R_S = 50 \Omega$	25°C		0.006	1*		0.006	1*	μV/mo
li o	Input offeet ourrent		25°C		6	90		6	90	n 1
IO	Input offset current		Full range			150			150	nA
l.o	Input bias current		25°C		15	90		15	90	nA
IB	input bias current		Full range			150			150	nA
VICR	Common-mode input	R <sub>S</sub> = 50 Ω	25°C	–11 to 11	-13 to 13		–11 to 11	-13 to 13		V
VICR	voltage range	11/5 = 30 12	Full range	-10.3 to 10.3			-10.4 to 10.4			V
		D. 600 O	25°C	10.5	12.9		10.5	12.9		
l.,	Maximum positive peak	$R_L = 600 \Omega$	Full range	10			10			.,,
VOM +	output voltage swing	D OLO	25°C	12	13.2		12	13.2		V
		$R_L = 2 k\Omega$	Full range	11			11			
		D. 600 O	25°C	-10.5	-13		-10.5	-13		
Vor	Maximum negative peak	R <sub>L</sub> = 600 Ω	Full range	-10			-10			V
VOM -	output voltage swing	$R_L = 2 k\Omega$	25°C	- 12	-13.5		- 12	-13.5		V
		V = 5 V25	Full range	- 11			- 11			
		$V_O = \pm 11 \text{ V, R}_L = 2 \text{ k}\Omega$	25°C	5	45		10	45		
	Lorge signal differential	$V_O = \pm 10 \text{ V}, R_L = 2 \text{ k}\Omega$	Full range	2.5			3.5			
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}, R_L = 1 \text{ k}\Omega$	25°C	3.5	38		8	38		V/µV
	5	VO = ± 10 V, IVL = 1 IV22	Full range	1.8			2.2			
		$V_0 = \pm 10 \text{ V}, R_L = 600 \Omega$	25°C	2	19		5	19		
Ci	Input capacitance		25°C		8			8		pF
z <sub>O</sub>	Open-loop output impedance	IO = 0	25°C		50			50		Ω
CMRR	Common-mode rejection	V <sub>IC</sub> = V <sub>ICR</sub> min,	25°C	100	131		117	131		dB
CIVIKK	ratio	$R_S = 50 \Omega$	Full range	96			113			uБ
kova	Supply-voltage rejection	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ $R_S = 50 \Omega$	25°C	94	144		110	144		dB
k <sub>SVR</sub>	ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ $R_S = 50 \Omega$	Full range	90			105			ub
loc	Supply current	V <sub>O</sub> = 0, No load	25°C		3.8	5.3		3.8	5.3	mA
ICC	Эарріу сапені	VO = 0, NO load	Full range			5.6			5.6	IIIA

<sup>\*</sup> On products compliant to MIL-PRF-38535, this parameter is not production tested.



<sup>†</sup> Full range is – 55°C to 125°C.

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

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### TLE20x7M operating characteristics at specified free-air temperature, V<sub>CC $\pm$ </sub> = $\pm$ 15 V, T<sub>A</sub> = 25°C (unless otherwise specified)

	DADAMETED	TEGT 001/DIT	2112		TLE20x7M			TLE20x7AM		
	PARAMETER	TEST CONDITI	ONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
		$R_L = 2 k\Omega$ ,	TLE2027	1.7	2.8		1.7	2.8		
		C <sub>L</sub> = 100 pF, See Figure 1	TLE2037	6*	7.5		6*	7.5		
SR	Slew rate at unity gain	$R_L = 2 k\Omega$ , $C_L = 100 pF$ ,	TLE2027	1			1			V/μs
		$T_A = -55^{\circ}C$ to 125°C, See Figure 1	TLE2037	4.4*			4.4*			
	Equivalent input noise	$R_S = 20 \Omega$ ,	f = 10 Hz		3.3	8*		3.3	4.5*	nV/√ <del>Hz</del>
V <sub>n</sub>	voltage (see Figure 2)	$R_S = 20 \Omega$ ,	f = 1 kHz		2.5	4.5*		2.5	3.8*	IIV/ \\ IIZ
V <sub>N(PP)</sub>	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 10 Hz			50	250*		50	130*	nV
	Equivalent input noise	f = 10 Hz			10			10		- A / /I I=
<sup>I</sup> n	current	f = 1 kHz			0.8			0.8		pA/√Hz
		V <sub>O</sub> = +10 V, A <sub>VD</sub> = 1, See Note 5	TLE2027		< 0.002%			< 0.002%		
THD	Total harmonic distortion	V <sub>O</sub> = +10 V, A <sub>VD</sub> = 5, See Note 5	TLE2037		< 0.002%			< 0.002%		
Б	Unity-gain bandwidth	$R_L = 2 k\Omega$ ,	TLE2027	7*	13		9*	13		N41.1-
B <sub>1</sub>	(see Figure 3)	C <sub>L</sub> = 100 pF	TLE2037	35	50		35	50		MHz
Post	Maximum output-swing	P 2 kO	TLE2027		30			30		kHz
ВОМ	bandwidth	$R_L = 2 k\Omega$	TLE2037		80			80		KПZ
,	Phase margin at unity	$R_L = 2 k\Omega$ ,	TLE2027		55°			55°		
Φm	gain (see Figure 3)	C <sub>L</sub> = 100 pF	TLE2037		50°			50°		

<sup>\*</sup> On products compliant to MIL-PRF-38535, this parameter is not production tested.

NOTE 5: Measured distortion of the source used in the analysis was 0.002%.



### TLE2027, TLE2037, TLE2027A, TLE2037A, TLE2027Y, TLE2037Y EXCALIBUR LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS SLOS192B - FEBRUARY 1997 - REVISED OCTOBER 2006

### TLE20x7Y electrical characteristics, $V_{CC\pm}$ = $\pm 15$ V, $T_A$ = 25°C (unless otherwise noted)

	DADAMETER	TEGT COMPLETIONS	TLE20x7Y		
	PARAMETER	TEST CONDITIONS	MIN TYP	MAX	UNIT
VIO	Input offset voltage		20		μV
	Input offset voltage long-term drift (see Note 4)	$V_{IC} = 0$ , $R_S = 50 \Omega$	0.006		μV/mo
I <sub>IO</sub>	Input offset current		6		nA
$I_{IB}$	Input bias current		15		nA
VICR	Common-mode input voltage range	R <sub>S</sub> = 50 Ω	-13 to 13		٧
.,		R <sub>L</sub> = 600 Ω	12.9		.,
VOM +	Maximum positive peak output voltage swing	R <sub>L</sub> = 2 kΩ	13.2		V
V	Markey and the season of the s	$R_L = 600 \Omega$	-13		V
VOM –	Maximum negative peak output voltage swing	$R_L = 2 k\Omega$	-13.5		V
		$V_O = \pm 11 \text{ V},  R_L = 2 \text{ k}\Omega$	45		
AVD	Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V},  R_L = 1 \text{ k}\Omega$	38		V/µV
700	Large signal uniterential voltage amplification	$V_O = \pm 10 \text{ V},$ $R_L = 600 \Omega$	19		V/μV
Ci	Input capacitance		8		pF
z <sub>O</sub>	Open-loop output impedance	IO = 0	50		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR}min,$ $R_S = 50 \Omega$	131		dB
ksvr	Supply-voltage rejection ratio ( $\Delta V_{CC\pm}$ / $\Delta V_{IO)}$	$V_{CC\pm} = \pm 4 \text{ V to } \pm 18 \text{ V},$ RS = 50 $\Omega$	144		dB
ICC	Supply current	$V_O = 0$ , No load	3.8		mA

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



### TLE2027, TLE2037, TLE2027A, TLE2037A, TLE2027Y, TLE2037Y EXCALIBUR LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS SLOS192B - FEBRUARY 1997 - REVISED OCTOBER 2006

### TLE20x7Y operating characteristics at specified free-air temperature, $V_{CC\,\pm}$ = $\pm 15~V$

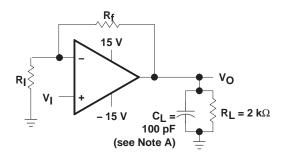
	242445752	TEST SOURITION	_	TLE20x7	<u>′</u>	
	PARAMETER	TEST CONDITION	8	MIN TYP	MAX	UNIT
CD	Class and a distribution in	$R_L = 2 k\Omega$ , $C_L = 100 pF$ ,	TLE2027	2.8	1	1//
SR	Slew rate at unity gain	See Figure 1	TLE2037	7.5	i	V/μs
.,	Faviralent input pains valtage (see Figure 2)	$R_S = 20 \Omega$ , $f = 10 Hz$		3.3	1	nV/√Hz
Vn	Equivalent input noise voltage (see Figure 2)	$R_S = 20 \Omega$ , $f = 1 \text{ kHz}$		2.5	i	IIV/∀⊓Z
V <sub>N(PP)</sub>	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 10 Hz		50	)	nV
	Embalant involves a size assessed	f = 10 Hz		10	)	pA/√Hz
In	Equivalent input noise current	f = 1 kHz		0.0	,	pA/√HZ
		V <sub>O</sub> = +10 V, A <sub>VD</sub> = 1, See Note 5	TLE2027	<0.002%		
THD	Total harmonic distortion	V <sub>O</sub> = +10 V, A <sub>VD</sub> = 5, See Note 5	TLE2037	<0.002%		
	He'to act has detaile (see Figure 0)	D 010 0 400 F	TLE2027	13	1	N41.1-
B <sub>1</sub>	Unity-gain bandwidth (see Figure 3)	$R_L = 2 k\Omega$ , $C_L = 100 pF$	TLE2037	50	)	MHz
		<b>D</b> 010	TLE2027	30	)	
ВОМ	Maximum output-swing bandwidth	$R_L = 2 k\Omega$	TLE2037	80	)	kHz
	Photo consideration that the second constitution of the second constitution	D 010 0 400 F	TLE2027	55°		
Φm	Phase margin at unity gain (see Figure 3)	$R_L = 2 k\Omega$ , $C_L = 100 pF$	TLE2037	50°		

NOTE 5: Measured distortion of the source used in the analysis was 0.002%.



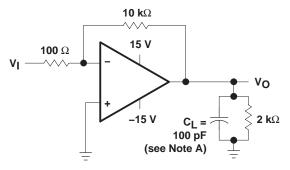
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### PARAMETER MEASUREMENT INFORMATION



NOTE A: C<sub>L</sub> includes fixture capacitance.

Figure 1. Slew-Rate Test Circuit



NOTE A: CL includes fixture capacitance.

Figure 3. Unity-Gain Bandwidth and Phase-Margin Test Circuit (TLE2027 Only)

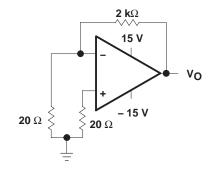
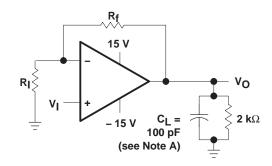


Figure 2. Noise-Voltage Test Circuit



NOTES: A. C<sub>L</sub> includes fixture capacitance. B. For the TLE2037 and TLE2037A,

AVD must be  $\geq 5$ .

Figure 4. Small-Signal Pulse-Response Test Circuit



### typical values

Typical values presented in this data sheet represent the median (50% point) of device parametric performance.

### initial estimates of parameter distributions

In the ongoing program of improving data sheets and supplying more information to our customers, Texas Instruments has added an estimate of not only the typical values but also the spread around these values. These are in the form of distribution bars that show the 95% (upper) points and the 5% (lower) points from the characterization of the initial wafer lots of this new device type (see Figure 5). The distribution bars are shown at the points where data was actually collected. The 95% and 5% points are used instead of  $\pm$  3 sigma since some of the distributions are not true Gaussian distributions.

The number of units tested and the number of different wafer lots used are on all of the graphs where distribution bars are shown. As noted in Figure 5, there were a total of 835 units from two wafer lots. In this case, there is a good estimate for the within-lot variability and a possibly poor estimate of the lot-to-lot variability. This is always the case on newly released products since there can only be data available from a few wafer lots.

The distribution bars are not intended to replace the minimum and maximum limits in the electrical tables. Each distribution bar represents 90% of the total units tested at a specific temperature. While 10% of the units tested fell outside any given distribution bar, this should not be interpreted to mean that the same individual devices fell outside every distribution bar.

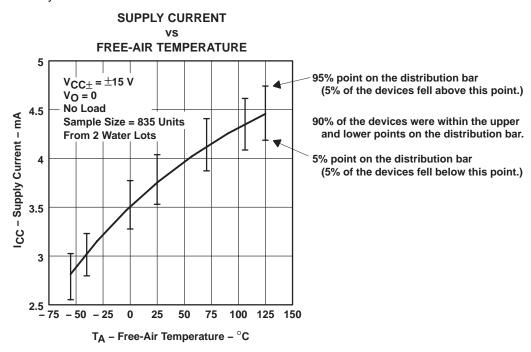


Figure 5. Sample Graph With Distribution Bars



### TLE2027, TLE2037, TLE2027A, TLE2037A, TLE2027Y, TLE2037Y **EXCALIBUR LOW-NOISE HIGH-SPEED** PRECISION OPERATIONAL AMPLIFIERS SLOS192B - FEBRUARY 1997 - REVISED OCTOBER 2006

### **TYPICAL CHARACTERISTICS**

### **Table of Graphs**

			FIGURE
V <sub>IO</sub>	Input offset voltage	Distribution	6, 7
$\Delta V_{IO}$	Input offset voltage change	vs Time after power on	8, 9
lio	Input offset current	vs Free-air temperature	10
I <sub>IB</sub>	Input bias current	vs Free-air temperature vs Common-mode input voltage	11 12
lį	Input current	vs Differential input voltage	13
V <sub>O(PP)</sub>	Maximum peak-to-peak output voltage	vs Frequency	14, 15
V <sub>OM</sub>	Maximum (positive/negative) peak output voltage	vs Load resistance vs Free-air temperature	16, 17 18, 19
AVD	Large-signal differential voltage amplification	vs Supply voltage vs Load resistance vs Frequency vs Free-air temperature	20 21 22 – 25 26
z <sub>O</sub>	Output impedance	vs Frequency	27
CMRR	Common-mode rejection ratio	vs Frequency	28
ksvr	Supply-voltage rejection ratio	vs Frequency	29
IOS	Short-circut output current	vs Supply voltage vs Elapsed time vs Free-air temperature	30, 31 32, 33 34, 35
ICC	Supply current	vs Supply voltage vs Free-air temperature	36 37
	Voltage-follower pulse response	Small signal Large signal	38, 40 39, 41
Vn	Equivalent input noise voltage	vs Frequency	42
	Noise voltage (referred to input)	Over 10-second interval	43
B <sub>1</sub>	Unity-gain bandwidth	vs Supply voltage vs Load capacitance	44 45
	Gain bandwidth product	vs Supply voltage vs Load capacitance	46 47
SR	Slew rate	vs Free-air temperature	48, 49
φт	Phase margin	vs Supply voltage vs Load capacitance vs Free-air temperature	50, 51 52, 53 54, 55
	Phase shift	vs Frequency	22 – 25

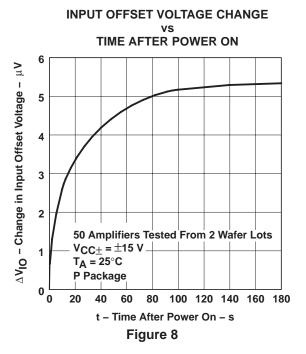


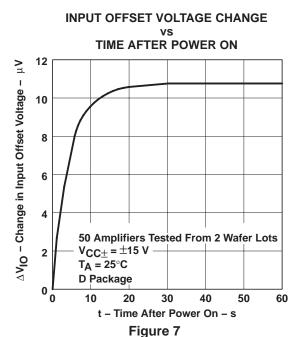
### **TYPICAL CHARACTERISTICS**

### **DISTRIBUTION INPUT OFFSET VOLTAGE** 16 1568 Amplifiers Tested From 2 Wafer Lots V<sub>CC±</sub> = +15 V\_ 14 $T_A = 25^{\circ}C$ D Package Percentage of Amplifiers - % 12 10 8 6 4 2 -120 - 90 - 60 - 30 0 90 120

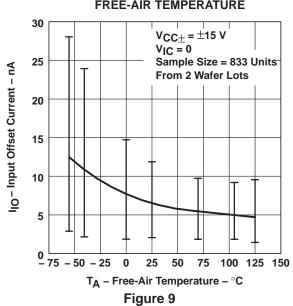


V<sub>IO</sub> - Input Offset Voltage - μV







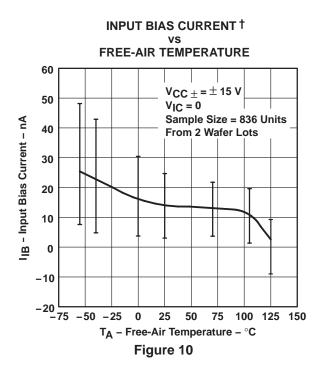


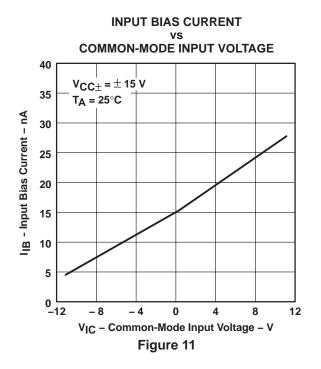
<sup>†</sup>Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

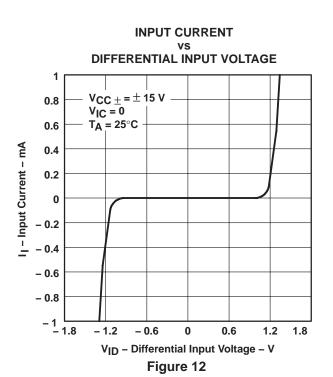


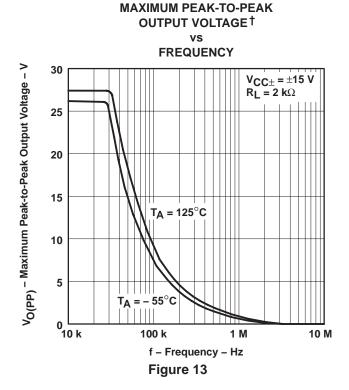
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### **TYPICAL CHARACTERISTICS**









**TLE2027** 

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

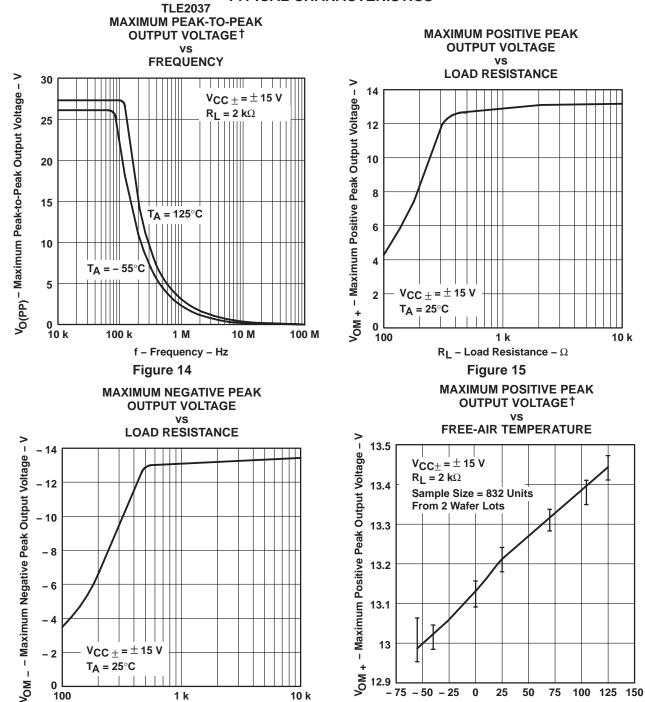


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T<sub>A</sub> - Free-Air Temperature - °C

Figure 17

#### TYPICAL CHARACTERISTICS



10 k

100

1 k

 $R_L$  – Load Resistance –  $\Omega$ 

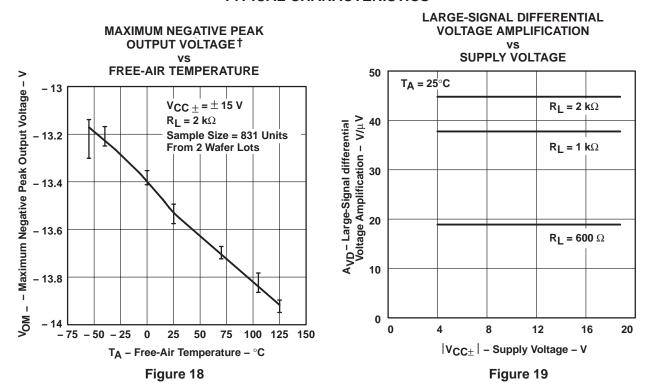
Figure 16



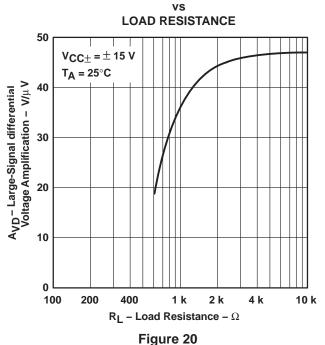
<sup>†</sup> Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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### TYPICAL CHARACTERISTICS



### LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION

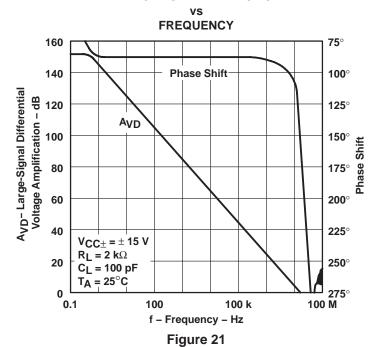


<sup>†</sup> Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



### **TYPICAL CHARACTERISTICS**

### TLE2027 LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT



TLE2037 LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT

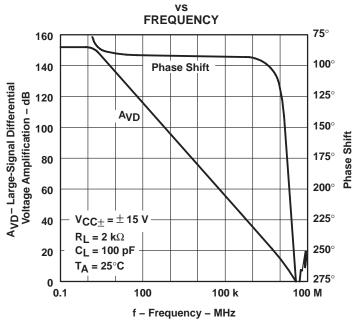
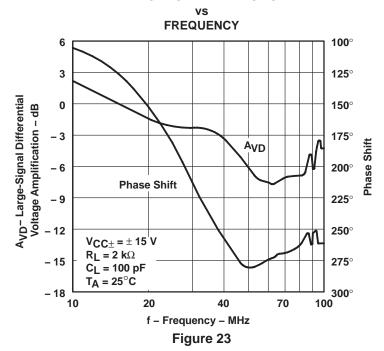


Figure 22

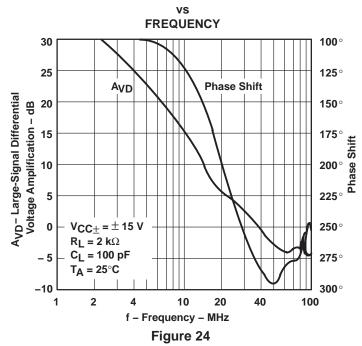


### **TYPICAL CHARACTERISTICS**

### TLE2027 LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT



### TLE2037 LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT





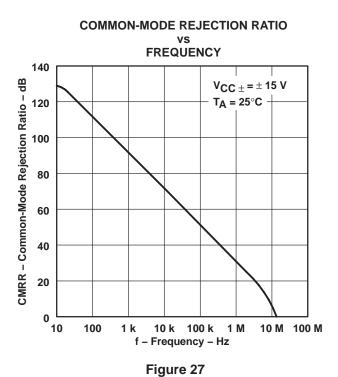
### **TYPICAL CHARACTERISTICS**

### LARGE-SIGNAL DIFFERENTIAL **VOLTAGE AMPLIFICATION†** vs FREE-AIR TEMPERATURE 60 $V_{CC} \pm = \pm 15 \text{ V}$ $A_{VD}-$ Large-Signal differential Voltage Amplification $-V/\mu V$ 50 $R_L = 2 k\Omega$ $R_L = 1 k\Omega$ 30 25 75 75 -50 -25 0 50 100 125 150 T<sub>A</sub> - Free-Air Temperature - °C

**OUTPUT IMPEDANCE** VS **FREQUENCY** 100  $V_{CC} \pm = \pm 15 V$ T<sub>A</sub> = 25°C  $z_0$  - Output Impedance -  $\Omega$ 10  $A_{VD} = 100$ See Note A  $A_{VD} = 10$ -10 -100 100 10 k 100 k 1 M 10 M 100 M 10 f - Frequency - Hz

NOTE A: For this curve, the TLE2027 is  $A_{VD}$  = 1 and the TLE2037 is  $A_{VD}$  = 5.

Figure 25



### SUPPLY-VOLTAGE REJECTION RATIO

Figure 26

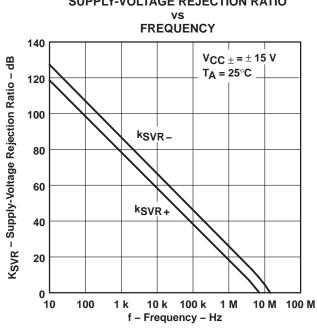


Figure 28

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



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### **TYPICAL CHARACTERISTICS**

### SHORT-CIRCUIT OUTPUT CURRENT **SUPPLY VOLTAGE** -42 $V_{ID} = 100 \text{ mV}$ IOS - Short-Circuit Output Current - mA $V_O = 0$ -40 $T_A = 25^{\circ}C$ P Package -38 -36 -34 -32-30 8 10 12 14 16 0 $|V_{CC\pm}|$ – Supply Voltage – V

Figure 29

### SHORT-CIRCUIT OUTPUT CURRENT vs

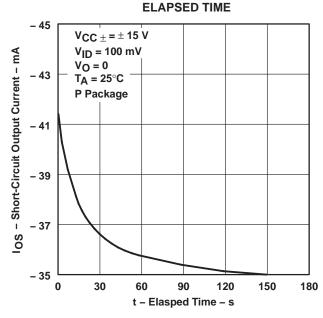


Figure 31

### SHORT-CIRCUIT OUTPUT CURRENT vs SUPPLY VOLTAGE

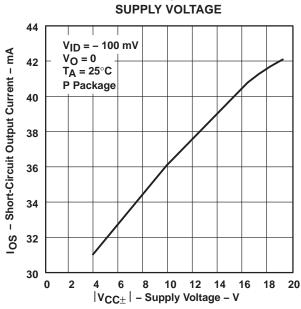


Figure 30

### SHORT-CIRCUIT OUTPUT CURRENT

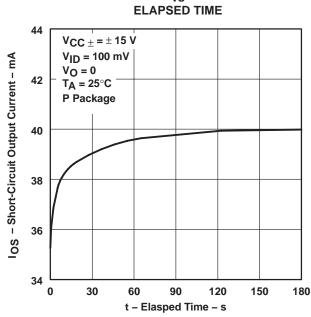


Figure 32



### **TYPICAL CHARACTERISTICS**

### SHORT-CIRCUIT OUTPUT CURRENT † FREE-AIR TEMPERATURE - 48 $V_{CC} \pm = \pm 15 V$ IOS - Short-Circuit Output Current - mA $V_{ID} = 100 \text{ mV}$ - 44 $V_O = 0$ P Package - 40 - 36 - 32 - 28 --75 -50 -25 25 50 75 100 125 150 T<sub>A</sub> - Free-Air Temperature - °C

Figure 33

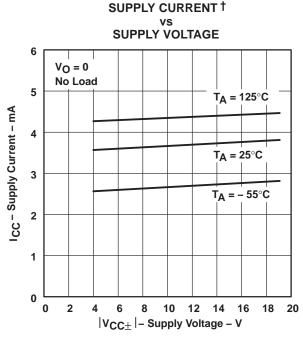


Figure 35

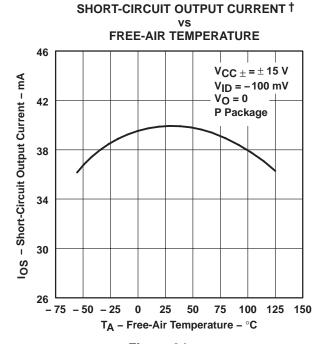


Figure 34

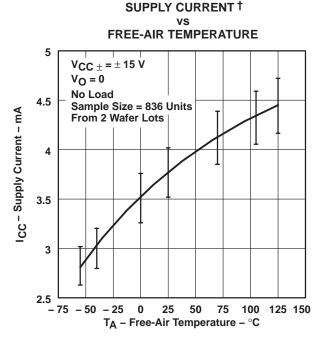


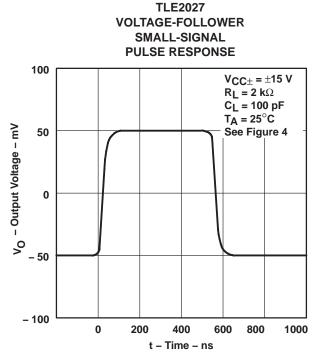
Figure 36

<sup>†</sup>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**



TLE2027 VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

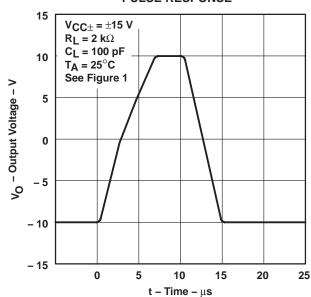
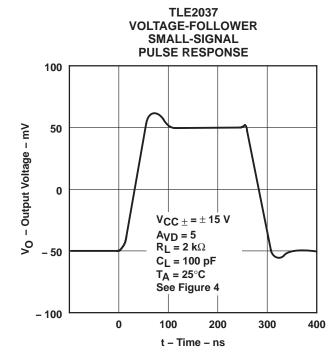


Figure 37

Figure 38



TLE2037 VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

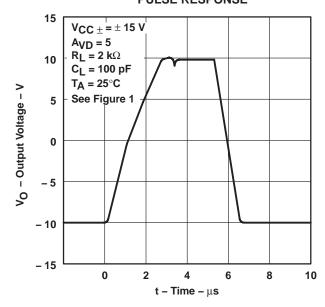


Figure 39 Figure 40



### **TYPICAL CHARACTERISTICS**

### EQUIVALENT INPUT NOISE VOLTAGE vs

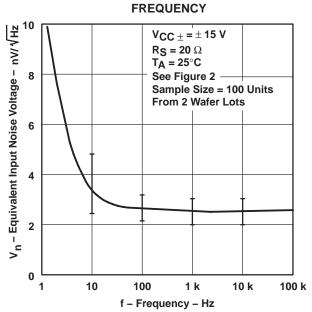


Figure 41

### NOISE VOLTAGE (REFERRED TO INPUT) OVER A 10-SECOND INTERVAL

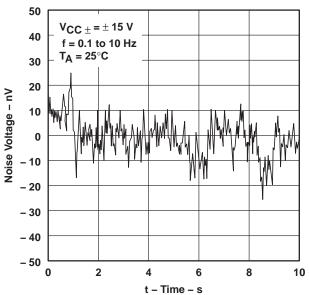
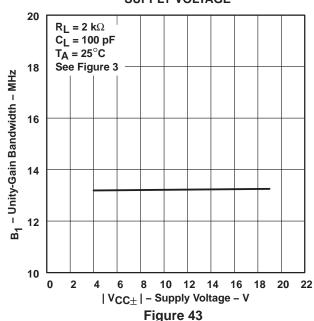


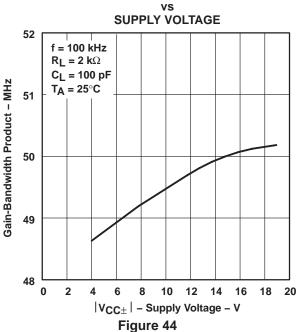
Figure 42

### TLE2027 UNITY-GAIN BANDWIDTH vs

### SUPPLY VOLTAGE



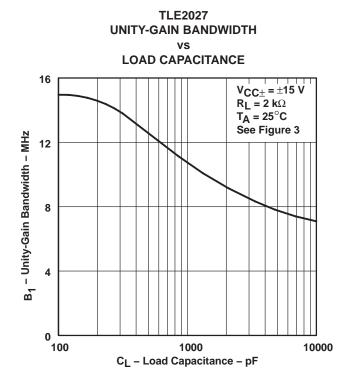
TLE2037 GAIN-BANDWIDTH PRODUCT





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#### TYPICAL CHARACTERISTICS



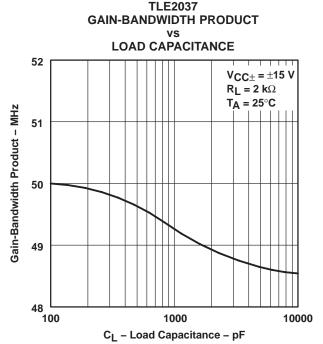
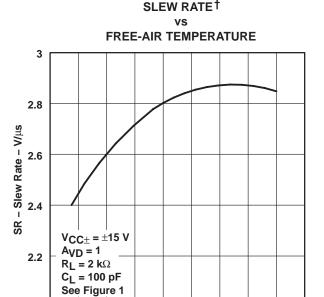


Figure 45

**TLE2027** 



25

 $T_A$  – Free-Air Temperature –  $^{\circ}C$ 

Figure 47

0

-75 - 50 - 25

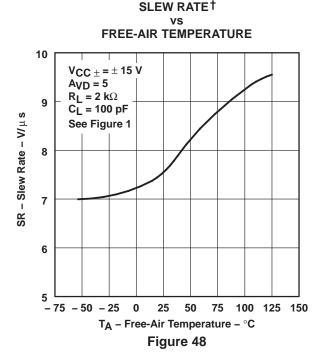
50

100

75

Figure 46

**TLE2037** 

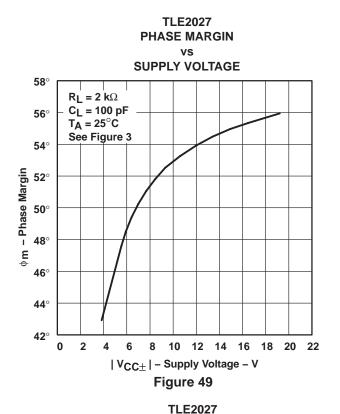


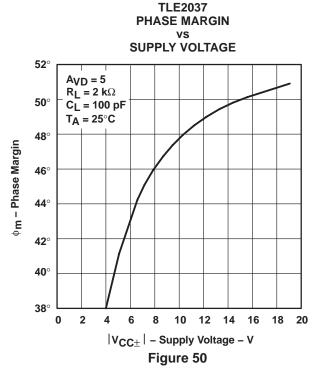
<sup>†</sup> Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

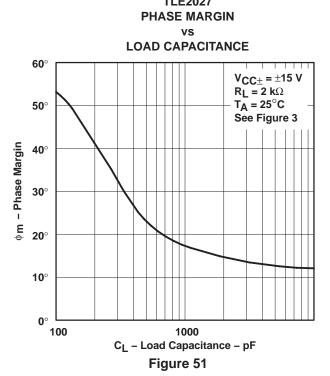
125 150

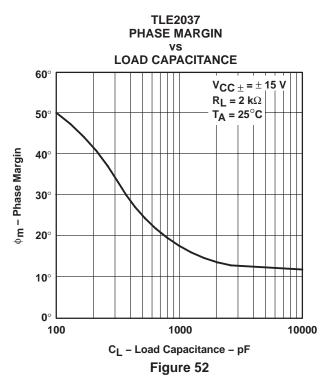


### **TYPICAL CHARACTERISTICS**



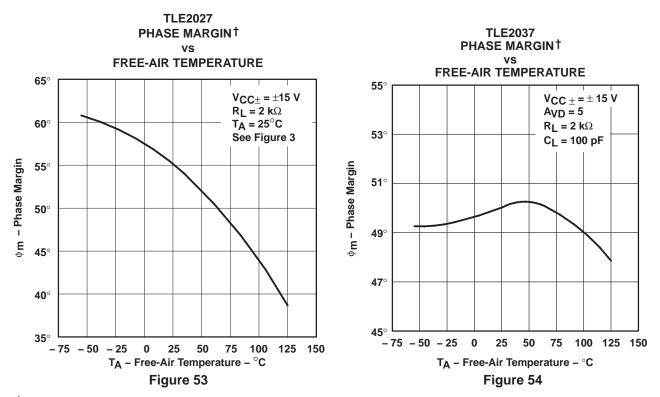






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### TYPICAL CHARACTERISTICS



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



#### APPLICATION INFORMATION

### input offset voltage nulling

The TLE2027 and TLE2037 series offers external null pins that can be used to further reduce the input offset voltage. The circuits of Figure 55 can be connected as shown if the feature is desired. If external nulling is not needed, the null pins may be left disconnected.

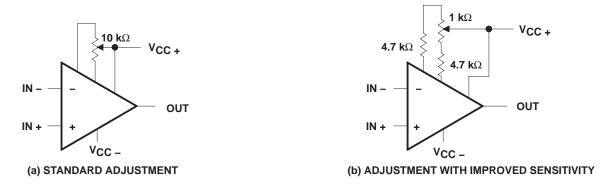


Figure 55. Input Offset Voltage Nulling Circuits

### voltage-follower applications

The TLE2027 circuitry includes input-protection diodes to limit the voltage across the input transistors; however, no provision is made in the circuit to limit the current if these diodes are forward biased. This condition can occur when the device is operated in the voltage-follower configuration and driven with a fast, large-signal pulse. It is recommended that a feedback resistor be used to limit the current to a maximum of 1 mA to prevent degradation of the device. Also, this feedback resistor forms a pole with the input capacitance of the device. For feedback resistor values greater than 10 k $\Omega$ , this pole degrades the amplifier phase margin. This problem can be alleviated by adding a capacitor (20 pF to 50 pF) in parallel with the feedback resistor (see Figure 56).

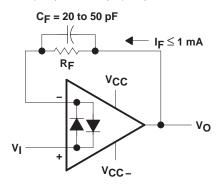


Figure 56. Voltage Follower



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#### 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 6) and subcircuit in Figure 57, Figure 58, and Figure 59 were generated using the TLE20x7 typical electrical and operating characteristics at 25°C. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

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

- Gain-bandwidth product
- Common-mode rejection ratio
- Phase margin
- DC output resistance
- AC output resistance
- Short-circuit output current limit

NOTE 6: 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).

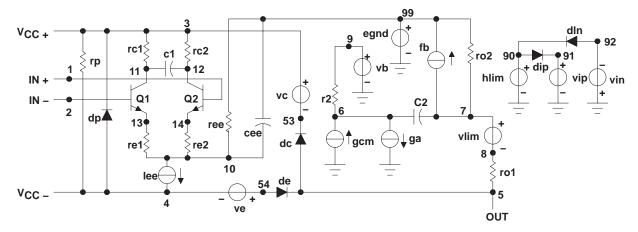


Figure 57. Boyle Macromodel

PSpice and Parts are trademarks of MicroSim Corporation.



### **APPLICATION INFORMATION**

### macromodel information (continued)

.subckt T	LE202	7 1 2	3 4	5		q2	12	1	14	dх
*						r2	6	9	100	.0E3
c1	11	12	4.00	3E-1	.2	rc1	3	11	530	.5
c2	6	7	20.0	0E-1	.2	rc2	3	12	530	.5
dc	5	53	dz			re1	13	10	-39	3.2
de	54	5	dz			re2	14	10	-39	3.2
dlp	90	91	dz			ree	10	99	3.5	71E6
dln	92	90	dx			ro1	8	5	25	
dp	4	3	dz			ro2	7	99	25	
egnd	99	0	poly	7(2)	(3,0)	rp	3	4	8.0	13E3
(4,0) 0 5	.5					vb	9	0	dc	0
fb	7	99	poly	<sup>7</sup> (5)	vb vc	VC	3	53	dc	2.400
ve vlp vl	n 0 9	54.8E	6 –1Ē	19 1E	9 1E9	ve	54	4	dc	2.100
-1E9 ¯						vlim	7	8	dc	0
ga	6	0	11	12		vlp	91	0	dc	40
2.062E-3						vln	0	92	dc	40
gcm	0	6	10	99		.modeldx	D(Is=	800.0	DE-18	)
531.3E-12						.modelqx	NPN(I	s = 800	0.0E-	18
iee	10	4	dc	56.0	1E-6	Bf = 7.0001	E3)			
hlim	90	0	vlim	1 1K		.ends				
<b>q1</b>	11	2	13 q	ίΧ						

Figure 58. TLE2027 Macromodel Subcircuit

.subckt	TLE203	7 1	2 3 4 5	q2	12	1	14	qz
*				r2	6	9	100	.0E3
c1	11	12	4.003E-12	rc1	3	11	471	.5
c2	6	7	7.500E-12	rc2	3	12	471	.5
dc	5	53	dz	re1	13	10	A44	8
de	54	5	dz	re2	14	10	A44	8
dlp	90	91	dz	ree	10	99	3.5	55E6
dln	92	90	dx	ro1	8	5	25	
dp	4	3	dz	ro2	7	99	25	
egnd	99	0	poly(2) (3,0)	rp	3	4	8.0	13E3
(4)	,0)0	.5	.5	vb	9	0	dc	0
fb	7	99	poly(5) vb vc	VC	3	53	dc	2.400
ve	vip vl	n 0	923.4E6 A800E6	ve	54	4	dc	2.100
800	DE6 800	E6 A	.800E6	vlim	7	8	dc	0
ga	6	0	11 12 2.121E-3	vlp	91	0	dc	40
gcm	0	6	10 99 597.7E-12	vln	0	92	dc	40
iee	10	4	dc 56.26E-6	.model	dxD	(Is=8	00.0E	E-18)
hlim	90	0	vlim 1K	.model	qxNl	PN(Is	=800.	0E-18
q1	11	2	13 qx	Bf=7.0	031E3	)		
				.ends				

Figure 59. TLE2037 Macromodel Subcircuit



### **PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	n MSL Peak Temp <sup>(3</sup>
5962-9089601M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9089601MPA	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
5962-9089602MPA	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
5962-9089603Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9089603QPA	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TLE2027ACD	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TLE2027ACP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2027AID	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TLE2027AIP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2027AMD	ACTIVE	SOIC	D	8	75	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLE2027AMDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2027AMFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TLE2027AMJG	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TLE2027AMJGB	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TLE2027CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2027CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027CP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2027ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027IP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2027MD	ACTIVE	SOIC	D	8	75	TBD	CU NIPDAU	Level-1-220C-UNLIN
TLE2027MDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIN
TLE2027MFKB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
TLE2027MJG	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TLE2027MJGB	ACTIVE	CDIP	JG	8	1	TBD	A42 SNPB	N / A for Pkg Type
TLE2037ACD	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TLE2037ACP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2037AID	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TLE2037AIP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2037AMD	ACTIVE	SOIC	D	8	75	TBD	CU NIPDAU	Level-1-220C-UNLIN
TLE2037AMDG4	ACTIVE	SOIC	D	8	75	Green (RoHS &	CU NIPDAU	Level-1-260C-UNLIN





18-Sep-2008

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	e Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
						no Sb/Br)		
TLE2037AMJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TLE2037CD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037CDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037CDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037CDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037CP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2037ID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037IDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037IDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037IDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037IP	OBSOLETE	PDIP	Р	8		TBD	Call TI	Call TI
TLE2037MD	ACTIVE	SOIC	D	8	75	TBD	CU NIPDAU	Level-1-220C-UNLIM
TLE2037MDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TLE2037MFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
TLE2037MJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI

<sup>&</sup>lt;sup>(1)</sup> The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

**Pb-Free** (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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### **PACKAGE OPTION ADDENDUM**

18-Sep-2008

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

### OTHER QUALIFIED VERSIONS OF TLE2027, TLE2027A, TLE2027AM, TLE2027M, TLE2037, TLE2037A:

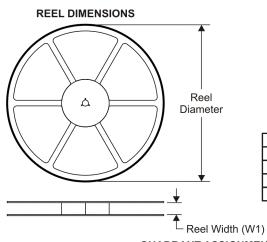
Automotive: TLE2037-Q1, TLE2037A-Q1
Enhanced Product: TLE2027-EP

NOTE: Qualified Version Definitions:

- Automotive Q100 devices qualified for high-reliability automotive applications targeting zero defects
   Enhanced Product Supports Defense, Aerospace and Medical Applications



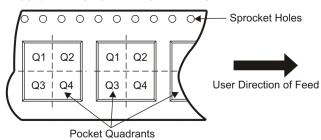
### TAPE AND REEL INFORMATION



# TAPE DIMENSIONS + K0 - P1 - B0 W Cavity - A0 -

	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



### \*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLE2027CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2027IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2037CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2037IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1





\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLE2027CDR	SOIC	D	8	2500	346.0	346.0	29.0
TLE2027IDR	SOIC	D	8	2500	346.0	346.0	29.0
TLE2037CDR	SOIC	D	8	2500	346.0	346.0	29.0
TLE2037IDR	SOIC	D	8	2500	346.0	346.0	29.0

### FK (S-CQCC-N\*\*)

#### **28 TERMINAL SHOWN**

### **LEADLESS CERAMIC CHIP CARRIER**



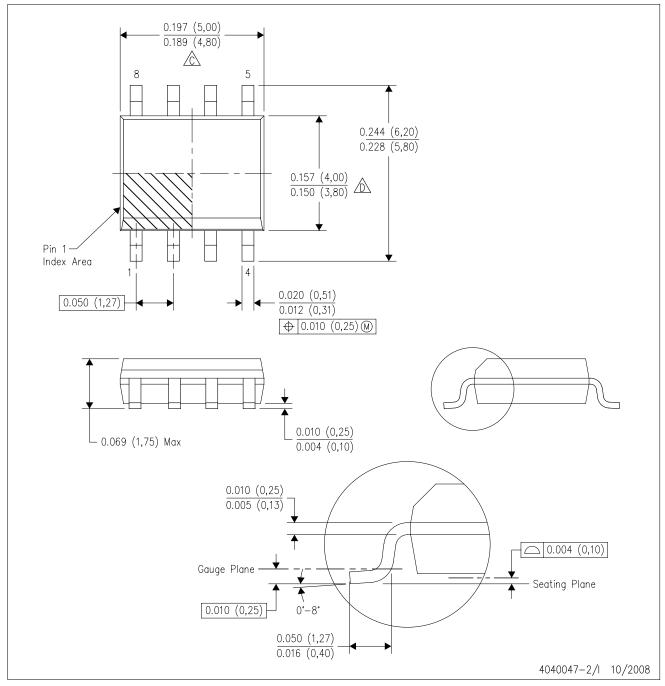
NOTES: A. All linear dimensions are in inches (millimeters).

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



### D (R-PDSO-G8)

### PLASTIC SMALL-OUTLINE PACKAGE



NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
- Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS-012 variation AA.



### P (R-PDIP-T8)

#### PLASTIC DUAL-IN-LINE



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

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

For the latest package information, go to  $http://www.ti.com/sc/docs/package/pkg\_info.htm$ 

### JG (R-GDIP-T8)

### **CERAMIC DUAL-IN-LINE**



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

- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification.
- E. Falls within MIL STD 1835 GDIP1-T8

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Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

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