

# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS181C – FEBRUARY 1997 – REVISED DECEMBER 2009

- Direct Upgrades to TL05x, TL07x, and TL08x BiFET Operational Amplifiers
- Greater Than 2× Bandwidth (10 MHz) and 3× Slew Rate (45 V/μs) Than TL07x
- Ensured Maximum Noise Floor 17 nV/√Hz
- On-Chip Offset Voltage Trimming for Improved DC Performance
- Wider Supply Rails Increase Dynamic Signal Range to ±19 V

## description

The TLE207x series of JFET-input operational amplifiers more than double the bandwidth and triple the slew rate of the TL07x and TL08x families of BiFET operational amplifiers. Texas Instruments Excalibur process yields a typical noise floor of 11.6 nV/√Hz, 17-nV/√Hz ensured maximum, offering immediate improvement in noise-sensitive circuits designed using the TL07x. The TLE207x also has wider supply voltage rails, increasing the dynamic signal range for BiFET circuits to ±19 V. On-chip zener trimming of offset voltage yields precision grades for greater accuracy in dc-coupled applications. The TLE207x are pin-compatible with lower performance BiFET operational amplifiers for ease in improving performance in existing designs.

BiFET operational amplifiers offer the inherently higher input impedance of the JFET-input transistors, without sacrificing the output drive associated with bipolar amplifiers. This makes them better suited for interfacing with high-impedance sensors or very low-level ac signals. They also feature inherently better ac response than bipolar or CMOS devices having comparable power consumption.

The TLE207x family of BiFET amplifiers are Texas Instruments highest performance BiFETs, with tighter input offset voltage and ensured maximum noise specifications. Designers requiring less stringent specifications but seeking the improved ac characteristics of the TLE207x should consider the TLE208x operational amplifier family.

Because BiFET operational amplifiers are designed for use with dual power supplies, care must be taken to observe common-mode input voltage limits and output swing when operating from a single supply. DC biasing of the input signal is required and loads should be terminated to a virtual ground node at mid-supply. Texas Instruments TLE2426 integrated virtual ground generator is useful when operating BiFET amplifiers from single supplies.

The TLE207x are fully specified at ±15 V and ±5 V. For operation in low-voltage and/or single-supply systems, Texas Instruments LinCMOS families of operational amplifiers (TLC- and TLV-prefix) are recommended. When moving from BiFET to CMOS amplifiers, particular attention should be paid to slew rate and bandwidth requirements and output loading.



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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.

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INSTRUMENTS**

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# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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## TLE2071 AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IOmax</sub> AT 25°C	PACKAGED DEVICES				
		SMALL OUTLINE† (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CERAMIC FLAT PACK (U)
0°C to 70°C	2 mV 4 mV	TLE2071ACD TLE2071CD	—	—	TLE2071ACP TLE2071CP	—
–40°C to 85°C	2 mV 4 mV	TLE2071AID TLE2071ID	—	—	TLE2071AIP TLE2071IP	—
–55°C to 125°C	2 mV 4 mV	— —	TLE2071AMFK TLE2071MFK	TLE2071AMJG TLE2071MJG	— —	TLE2071AMU TLE2071MU

† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLE2071ACDR).

## TLE2072 AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IOmax</sub> AT 25°C	PACKAGED DEVICES				
		SMALL OUTLINE† (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CERAMIC FLAT PACK (U)
0°C to 70°C	3.5 mV 6 mV	TLE2072ACD TLE2072CD	—	—	TLE2072ACP TLE2072CP	—
–40°C to 85°C	3.5 mV 6 mV	TLE2072AID TLE2072ID	—	—	TLE2072AIP TLE2072IP	—
–55°C to 125°C	3.5 mV 6 mV	—	TLE2072AMFK TLE2072MFK	TLE2072AMJG TLE2072MJG	—	TLE2072AMU TLE2072MU

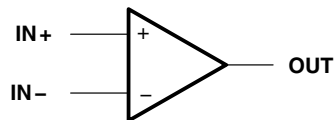
† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLE2072ACDR).

## TLE2074 AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IOmax</sub> AT 25°C	PACKAGED DEVICES				
		SMALL OUTLINE† (DW)	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	CERAMIC FLAT PACK (W)
0°C to 70°C	3 mV 5 mV	TLE2074ACDW TLE2074CDW	—	—	TLE2074ACN TLE2074CN	—
–40°C to 85°C	3 mV 5 mV	TLE2074AIDW TLE2074IDW	—	—	TLE2074AIN TLE2074IN	—
–55°C to 125°C	3 mV 5 mV	—	TLE2074AMFK TLE2074MFK	TLE2074AMJ TLE2074MJ	—	TLE2074AMW TLE2074MW

† The DW packages are available taped and reeled. Add R suffix to device type (e.g., TLE2074ACDWR).

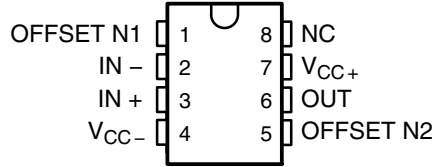
## symbol



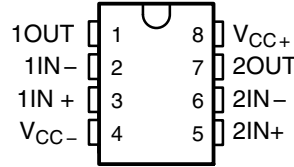
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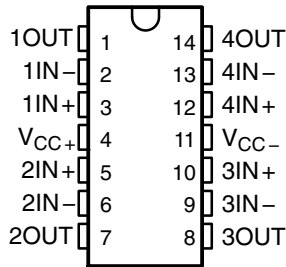
**TLE2071 AND TLE2071A  
D, JG, OR P PACKAGE  
(TOP VIEW)**



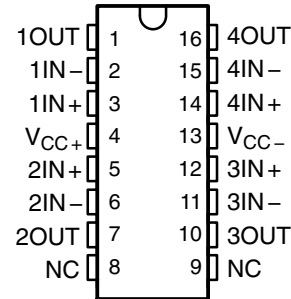
**TLE2072 AND TLE2072A  
D, JG, OR P PACKAGE  
(TOP VIEW)**



**TLE2074 AND TLE2074A  
J, N, OR W PACKAGE  
(TOP VIEW)**



**TLE2074 AND TLE2074A  
DW PACKAGE  
(TOP VIEW)**



**TLE2071M AND TLE2071AM  
FK PACKAGE  
(TOP VIEW)**



**TLE2072M AND TLE2072AM  
FK PACKAGE  
(TOP VIEW)**



**TLE2074M AND TLE2074AM  
FK PACKAGE  
(TOP VIEW)**



**TLE2071 AND TLE2071A  
U PACKAGE  
(TOP VIEW)**



**TLE2072 AND TLE2072A  
U PACKAGE  
(TOP VIEW)**



NC – No internal connection

**TLE207X, TLE207XA**  
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equivalent schematic



NOTES: A. OFFSET N1 AND OFFSET N2 are only available on the TLE2071x devices.

equivalent schematic (continued)

ACTUAL DEVICE COMPONENT COUNT			
COMPONENT	TLE2071	TLE2072	TLE2074
Transistors	33	57	114
Resistors	25	37	74
Diodes	8	5	10
Capacitors	6	11	22

# TLE207x, TLE207xA

## EXCALIBUR LOW-NOISE HIGH-SPEED

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

Supply voltage, $V_{CC+}$ (see Note 1)	19 V
Supply voltage, $V_{CC-}$ (see Note 1)	-19 V
Differential input voltage range, $V_{ID}$ (see Note 2)	$V_{CC+}$ to $V_{CC-}$
Input voltage range, $V_I$ (any input)	$V_{CC+}$ to $V_{CC-}$
Input current, $I_I$ (each input)	$\pm 1$ mA
Output current, $I_O$ (each output)	$\pm 80$ mA
Total current into $V_{CC+}$	160 mA
Total current out of $V_{CC-}$	160 mA
Duration of short-circuit current at (or below) 25°C (see Note 3)	unlimited
Package thermal impedance, $\theta_{JA}$ (see Notes 4 and 5):	
D package	97.1°C/W
DW package	57.3°C/W
N package	79.7°C/W
P package	84.6°C/W
Package thermal impedance, $\theta_{JC}$ (see Notes 4 and 5):	
FK package	5.6°C/W
J package	15.1°C/W
JG package	14.5°C/W
U package	14.7°C/W
W package	10°C/W
Operating free-air temperature range, $T_A$ : C suffix	0°C to 70°C
I suffix	-40°C to 85°C
M suffix	-55°C to 125°C
Storage temperature range	-65°C to 150°C
Case temperature for 60 seconds: FK package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: DW or N package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J, JG, U, or W 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:
- All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
  - Differential voltages are at the noninverting input with respect to the inverting input.
  - The output may be shorted to either supply. Temperatures and/or supply voltages must be limited to ensure that the maximum dissipation rate is not exceeded.
  - Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A) / \theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
  - The package thermal impedance is calculated in accordance with JEDEC 51-7 (plastic) or MIL-STD-883 Method 1012 (ceramic).

#### recommended operating conditions

		C SUFFIX		I SUFFIX		M SUFFIX		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC\pm}$		$\pm 2.25$	$\pm 19$	$\pm 2.25$	$\pm 19$	$\pm 2.25$	$\pm 19$	V
Common-mode input voltage, $V_{IC}$	$V_{CC\pm} = \pm 5$ V	-0.9	5	-0.8	5	-0.8	5	V
	$V_{CC\pm} = \pm 15$ V	-10.9	15	-10.8	15	-10.8	15	
Operating free-air temperature, $T_A$		0	70	-40	85	-55	125	°C



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**TLE2071C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2071C			TLE2071AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega$	25°C	0.34	4		0.3	2	mV		
		Full range			6		4			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29		3.2	29	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range		1.4			1.4	nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range		5			5	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.9			5 to -0.9				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.7			3.7				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.4			3.4				
	$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3			
		Full range	1.5			1.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.5	-4.2		-3.5	-4.2	V		
		Full range	-3.4			-3.4				
	$I_O = 2\ \text{mA}$	25°C	-3.7	-4.1		-3.7	-4.1			
		Full range	-3.6			-3.6				
	$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4			
		Full range	-1.5			-1.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	79			79			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	89			89			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	11			11			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

$^\dagger$  Full range is 0°C to 70°C.



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**TLE2071C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current	$V_O = 0$ , No load	25°C	1.35	1.6	2.2	1.35	1.6	2.2	mA
		Full range				2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1\text{ V}$			-35			mA
			$V_{ID} = -1\text{ V}$			45			

† Full range is 0°C to 70°C.

**TLE2071C operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+ Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	35			35			V/ $\mu$ s
		Full range	23			23			
SR- Negative slew rate		25°C	38			38			V/ $\mu$ s
		Full range	23			23			
$t_s$ Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	25°C	To 10 mV			0.25			$\mu$ s
			To 1 mV			0.4			
$V_n$ Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	25°C	f = 10 Hz		48	85	48	85	nV/ $\sqrt{\text{Hz}}$
			f = 10 kHz		12	17	12	17	
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		25°C	f = 10 Hz to 10 kHz		6		6		$\mu$ V
			f = 0.1 Hz to 10 Hz		0.6		0.6		
$I_n$ Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	$A_{VD} = 10$ , $R_L = 2\text{ k}\Omega$ , 25°C	0.013%			0.013%			
$B_1$ Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 25\text{ pF}$ , $A_{VD} = -1$	25°C	2.8			2.8			MHz
$\phi_m$ Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	56°			56°			

† Full range is 0°C to 70°C.





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**TLE2071C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega$ $V_O = 0,$	25°C	0.49	4		0.47	2	mV		
		Full range			6		4			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29		3.2	29	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	6	100		6	100	pA		
		Full range		1.4			1.4	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range		5			5	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.9			15 to -10.9				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu A$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.7			13.7				
	$I_O = -2$ mA	25°C	13.5	13.9		13.5	13.9			
		Full range	13.4			13.4				
	$I_O = -20$ mA	25°C	11.5	12.3		11.5	12.3			
		Full range	11.5			11.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu A$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.7			-13.7				
	$I_O = 2$ mA	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.4			-13.4				
	$I_O = 20$ mA	25°C	-11.5	-12.4		-11.5	-12.4			
		Full range	-11.5			-11.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10$ V	$R_L = 600 \Omega$	25°C	80	96		80	96	dB	
			Full range	79			79			
		$R_L = 2$ k $\Omega$	25°C	90	109		90	109		
			Full range	89			89			
		$R_L = 10$ k $\Omega$	25°C	95	118		95	118		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	7.5			7.5			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1$ MHz	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	80	98		80	98	dB		
		Full range	79			79				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	80			81				

† Full range is 0°C to 70°C.



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**TLE2071C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current	$V_O = 0$ , No load	25°C	1.35	1.7	2.2	1.35	1.7	2.2	mA
		Full range	2.2			2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1$ V	-30	-45		-30	-45		mA
		$V_{ID} = -1$ V	30	48		30	48		

† Full range is 0°C to 70°C.

**TLE2071C operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+ Positive slew rate	$V_{O(PP)} = 10$ V, $A_{VD} = -1$ , $R_L = 2$ k $\Omega$ , See Figure 1	25°C	30	40		30	40		V/ $\mu$ s
		Full range	27			27			
SR- Negative slew rate		25°C	30	45		30	45		V/ $\mu$ s
		Full range	27			27			
$t_s$ Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	To 10 mV	0.4			0.4			$\mu$ s
		To 1 mV	1.5			1.5			
$V_n$ Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	f = 10 Hz	48	85		48	85		nV/ $\sqrt{Hz}$
		f = 10 kHz	12	17		12	17		
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu$ V
		f = 0.1 Hz to 10 Hz	0.6			0.6			
$I_n$ Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{Hz}$
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 20$ V, $A_{VD} = 10$ , f = 1 kHz, $R_L = 2$ k $\Omega$ , $R_S = 25$ $\Omega$	25°C	0.008%			0.008%			
$B_1$ Unity-gain bandwidth	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	8	10		8	10		MHz
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 20$ V, $A_{VD} = -1$ , $R_L = 2$ k $\Omega$ , $C_L = 25$ pF	25°C	478	637		478	637		kHz
$\phi_m$ Phase margin at unity gain	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	57°			57°			

† Full range is 0°C to 70°C.



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**TLE2071I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071I			TLE2071AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega,$ $V_O = 0,$	25°C	0.34	4		0.3	2	mV		
		Full range			7.6		5.6			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29		3.2	29	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range		5		5		nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range		10		10		nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.8			5 to -0.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu A$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.7			3.7				
	$I_O = -2$ mA	25°C	3.5	3.9		3.5	3.9			
		Full range	3.4			3.4				
	$I_O = -20$ mA	25°C	1.5	2.3		1.5	2.3			
		Full range	1.5			1.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu A$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.7			-3.7				
	$I_O = 2$ mA	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.4			-3.4				
	$I_O = 20$ mA	25°C	-1.5	-2.4		-1.5	-2.4			
		Full range	-1.5			-1.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3$ V	$R_L = 600 \Omega$	25°C	80	91		80	91	dB	
			Full range	79			79			
		$R_L = 2$ k $\Omega$	25°C	90	100		90	100		
			Full range	89			89			
		$R_L = 10$ k $\Omega$	25°C	95	106		95	106		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	11			11			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1$ MHz	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

† Full range is  $-40^\circ C$  to  $85^\circ C$ .



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**TLE2071I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2071I			TLE2071AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current	$V_O = 0$ , No load	25°C	1.35	1.6	2.2	1.35	1.6	2.2	mA
		Full range				2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1\text{ V}$	-35			-35			mA
		$V_{ID} = -1\text{ V}$	45			45			

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

**TLE2071I operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2071I			TLE2071AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+ Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , See Figure 1	25°C	35			35			V/ $\mu\text{s}$
		Full range	22			22			
SR- Negative slew rate		25°C	38			38			V/ $\mu\text{s}$
		Full range	22			22			
$t_s$ Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.25			0.25			$\mu\text{s}$
		To 1 mV	0.4			0.4			
$V_n$ Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz	48	85		48	85	nV/ $\sqrt{\text{Hz}}$	
		f = 10 kHz	12	17		12	17		
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu\text{V}$
		f = 0.1 Hz to 10 Hz	0.6			0.6			
$I_n$ Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , $A_{VD} = 10$ , f = 1 kHz, $R_L = 2\text{ k}\Omega$ , $R_S = 25\ \Omega$	25°C	0.013%			0.013%			
$B_1$ Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 25\text{ pF}$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $A_{VD} = -1$ , $R_L = 2\text{ k}\Omega$ , $C_L = 25\text{ pF}$	25°C	2.8			2.8			MHz
$\phi_m$ Phase margin at unity gain	$V_I = 10\text{ mV}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 25\text{ pF}$ , See Figure 2	25°C	56°			56°			

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TLE20711 electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE20711			TLE2071AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega,$ $V_O = 0,$	25°C	0.49	4		0.47	2	mV		
		Full range			7.6		5.6			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29		3.2	29	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	6	100		6	100	pA		
		Full range		5			5	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range		10			10	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.8			15 to -10.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu\text{A}$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.7			13.7				
	$I_O = -2 \text{ mA}$	25°C	13.5	13.9		13.5	13.9			
		Full range	13.4			13.4				
	$I_O = -20 \text{ mA}$	25°C	11.5	12.3		11.5	12.3			
		Full range	11.5			11.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu\text{A}$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.7			-13.7				
	$I_O = 2 \text{ mA}$	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.4			-13.4				
	$I_O = 20 \text{ mA}$	25°C	-11.5	-12.4		-11.5	-12.4			
		Full range	-11.5			-11.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$	$R_L = 600 \Omega$	25°C	80	96		80	96	dB	
			Full range	79			79			
		$R_L = 2 \text{ k}\Omega$	25°C	90	109		90	109		
			Full range	89			89			
		$R_L = 10 \text{ k}\Omega$	25°C	95	118		95	118		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	7.5			7.5			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1 \text{ MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	80	98		80	98	dB		
		Full range	79			79				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5 \text{ V to } \pm 15 \text{ V},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TLE2071I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071I			TLE2071AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current	$V_O = 0$ , No load	25°C	1.35	1.7	2.2	1.35	1.7	2.2	mA
		Full range	2.2			2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1$ V	-30	-45	-30	-45	mA	
			$V_{ID} = -1$ V	30	48	30	48		

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

**TLE2071I operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071I			TLE2071AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+ Positive slew rate	$V_{O(PP)} = \pm 10$ V, $A_{VD} = -1$ , $C_L = 100$ pF, $R_L = 2$ k $\Omega$ , See Figure 1	25°C	30	40		30	40	V/ $\mu$ s	
		Full range	24			24			
SR- Negative slew rate		25°C	30	45		30	45	V/ $\mu$ s	
		Full range	24			24			
$t_s$ Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	25°C	To 10 mV	0.4		0.4		$\mu$ s	
			To 1 mV	1.5		1.5			
$V_n$ Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz	48	85	48	85	nV/ $\sqrt{\text{Hz}}$	
			f = 10 kHz	12	17	12	17		
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		25°C	f = 10 Hz to 10 kHz	6		6		$\mu$ V	
			f = 0.1 Hz to 10 Hz	0.6		0.6			
$I_n$ Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8		2.8		fA/ $\sqrt{\text{Hz}}$		
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 20$ V, f = 1 kHz, $R_S = 25$ $\Omega$	$A_{VD} = 10$ , $R_L = 2$ k $\Omega$ ,	25°C	0.008%		0.008%			
$B_1$ Unity-gain bandwidth	$V_I = 10$ mV, $C_L = 25$ pF,	$R_L = 2$ k $\Omega$ , See Figure 2	25°C	8	10	8	10	MHz	
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 20$ V, $R_L = 2$ k $\Omega$ ,	$A_{VD} = -1$ , $C_L = 25$ pF	25°C	478	637	478	637	kHz	
$\phi_m$ Phase margin at unity gain	$V_I = 10$ mV, $C_L = 25$ pF,	$R_L = 2$ k $\Omega$ , See Figure 2	25°C	57°		57°			

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TLE2071M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2071M			TLE2071AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega,$ $V_O = 0,$	25°C	0.34	4		0.3	2	mV		
		Full range			9.2		7.2			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29 <sup>‡</sup>		3.2	29 <sup>‡</sup>	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range			20		20	nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range			60		60	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.8			5 to -0.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.6			3.6				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.3			3.3				
	$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3			
		Full range	1.4			1.4				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.6			-3.6				
	$I_O = 2\ \text{mA}$	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.3			-3.3				
	$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4			
		Full range	-1.4			-1.4				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	78			78			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	88			88			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	93			93			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	11			11			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V}$ to $\pm 15\ \text{V},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

<sup>†</sup> Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

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



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**TLE2071M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2071M			TLE2071AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current	$V_O = 0$ , No load	25°C	1.35	1.6	2.2	1.35	1.6	2.2	mA
		Full range	2.2			2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1\text{ V}$	-35			-35			mA
		$V_{ID} = -1\text{ V}$	45			45			

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**TLE2071M operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2071M			TLE2071AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+ Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	35			35			V/ $\mu\text{s}$	
		Full range	20 <sup>‡</sup>			20 <sup>‡</sup>				
SR- Negative slew rate		25°C	38			38			V/ $\mu\text{s}$	
		Full range	20 <sup>‡</sup>			20 <sup>‡</sup>				
$t_s$ Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.25			0.25			$\mu\text{s}$	
		To 1 mV	0.4			0.4				
$V_n$ Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz	48	85 <sup>‡</sup>		48	85 <sup>‡</sup>	nV/ $\sqrt{\text{Hz}}$		
		f = 10 kHz	12	17 <sup>‡</sup>		12	17 <sup>‡</sup>			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		f = 10 Hz to 10 kHz	6			6			$\mu\text{V}$	
		f = 0.1 Hz to 10 Hz	0.6			0.6				
$I_n$ Equivalent input noise current		$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$
THD + N Total harmonic distortion plus noise		$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	$A_{VD} = 10$ , $R_L = 2\text{ k}\Omega$ , 25°C	0.013%			0.013%			
$B_1$ Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	9.4			9.4			MHz	
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 25\text{ pF}$	$A_{VD} = -1$ , 25°C	2.8			2.8			MHz	
$\phi_m$ Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	56°			56°				

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

‡ \*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.





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**TLE2071M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071M			TLE2071AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega$ $V_O = 0,$	25°C	0.49	4		0.47	2	mV		
		Full range			9.2		7.2			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29*		3.2	29*	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	6	100		6	100	pA		
		Full range			20		20	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range			60		60	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.9			15 to -10.9				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu\text{A}$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.6			13.6				
	$I_O = -2 \text{ mA}$	25°C	13.5	13.9		13.5	13.9			
		Full range	13.3			13.3				
	$I_O = -20 \text{ mA}$	25°C	11.5	12.3		11.5	12.3			
		Full range	11.4			11.4				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu\text{A}$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.6			-13.6				
	$I_O = 2 \text{ mA}$	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.3			-13.3				
	$I_O = 20 \text{ mA}$	25°C	-11.5	-12.4		-11.5	-12.4			
		Full range	-11.4			-11.4				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$	$R_L = 600 \Omega$	25°C	80	96		80	96	dB	
			Full range	78			78			
		$R_L = 2 \text{ k}\Omega$	25°C	90	109		90	109		
			Full range	88			88			
		$R_L = 10 \text{ k}\Omega$	25°C	95	118		95	118		
			Full range	93			93			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	7.5			7.5			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1 \text{ MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	80	98		80	98	dB		
		Full range	78			78				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5 \text{ V to } \pm 15 \text{ V},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

\*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .



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**TLE2071M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071M			TLE2071AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current	$V_O = 0$ , No load	25°C	1.35	1.7	2.2	1.35	1.7	2.2	mA
		Full range	2.2			2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1$ V	-30	-45		-30	-45		mA
		$V_{ID} = -1$ V	30	48		30	48		

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**TLE2071M operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071M			TLE2071AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+ Positive slew rate	$V_{O(PP)} = 10$ V, $A_{VD} = -1$ , $R_L = 2$ k $\Omega$ , $C_L = 100$ pF, See Figure 1	25°C	30	40		30	40		V/ $\mu$ s	
		Full range	22			22				
SR- Negative slew rate		25°C	30	45		30	45		V/ $\mu$ s	
		Full range	22			22				
$t_s$ Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	To 10 mV	0.4			0.4			$\mu$ s	
		To 1 mV	1.5			1.5				
$V_n$ Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	f = 10 Hz	48	85*		48	85*		nV/ $\sqrt{\text{Hz}}$	
		f = 10 kHz	12	17*		12	17*			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		f = 10 Hz to 10 kHz	6			6			$\mu$ V	
		f = 0.1 Hz to 10 Hz	0.6			0.6				
$I_n$ Equivalent input noise current		$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$
THD + N Total harmonic distortion plus noise		$V_{O(PP)} = 20$ V, f = 1 kHz, $R_S = 25$ $\Omega$	25°C	0.008%			0.008%			
$B_1$ Unity-gain bandwidth	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	8*	10		8*	10		MHz	
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 20$ V, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF	25°C	478*	637		478*	637		kHz	
$\phi_m$ Phase margin at unity gain	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	57°			57°				

\*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .



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**TLE2071Y electrical characteristics at  $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$**

PARAMETER	TEST CONDITIONS	TLE2071Y			UNIT
		MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0$ , $V_O = 0$ , $R_S = 50\ \Omega$		0.49	4	mV
$I_{IO}$ Input offset current	$V_{IC} = 0$ , $V_O = 0$ , See Figure 4		6	100	pA
$I_{IB}$ Input bias current			20	175	pA
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	15 to -11	15 to 11.9		V
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	13.8	14.1		V
	$I_O = -2\ \text{mA}$	13.5	13.9		
	$I_O = -20\ \text{mA}$	11.5	12.3		
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	-13.8	-14.2		V
	$I_O = 2\ \text{mA}$	-13.5	-14		
	$I_O = 20\ \text{mA}$	-11.5	-12.4		
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10\ \text{V}$	$R_L = 600\ \Omega$	80	96	dB
		$R_L = 2\ \text{k}\Omega$	90	109	
		$R_L = 10\ \text{k}\Omega$	95	118	
$r_i$ Input resistance	$V_{IC} = 0$	$10^{12}$		$\Omega$	
$c_i$ Input capacitance	$V_O = 0$ , See Figure 5	Common mode	7.5		pF
		Differential	2.5		
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	80		$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$ , $R_S = 50\ \Omega$ , $V_O = 0$	80	98	dB	
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V}$ , $R_S = 50\ \Omega$ , $V_O = 0$	82	99	dB	
$I_{CC}$ Supply current	$V_O = 0$ , No load	1.35	1.7	2.2	mA
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1\ \text{V}$	-30	-45	mA
		$V_{ID} = -1\ \text{V}$	30	48	

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**TLE2072C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072C			TLE2072AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0,$ $R_S = 50\ \Omega$	25°C	0.9	6		0.65	3.5	mV		
		Full range			7.8		5.3			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2.3	25		2.3	25	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range			1.4		1.4	nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range			5		5	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.9			5 to -0.9				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.7			3.7				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.4			3.4				
$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3				
	Full range	1.5			1.5					
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.7			-3.7				
	$I_O = 2\ \text{mA}$	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.4			-3.4				
$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4				
	Full range	-1.5			-1.5					
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	79			79			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	89			89			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	11			11			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0, R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V},$ $V_O = 0, R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

† Full range is 0°C to 70°C.



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**TLE2072C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**  
**(continued)**

PARAMETER	TEST CONDITIONS	$T_A$	TLE2072C			TLE2072AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load	25°C	2.7	2.9	3.9	2.7	2.9	3.9	mA
			Full range	3.9			3.9			
$a_x$	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	$V_{ID} = 1\text{ V}$	-35			-35			mA
			$V_{ID} = -1\text{ V}$	45			45			

**TLE2072C operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072C			TLE2072AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+	Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	35			35			$\text{V}/\mu\text{s}$
			Full range	22			22			
SR-	Negative slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	38			38			$\text{V}/\mu\text{s}$
			Full range	22			22			
$t_s$	Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.25			0.25			$\mu\text{s}$
			To 1 mV	0.4			0.4			
$V_n$	Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz	48	85		48	85		$\text{nV}/\sqrt{\text{Hz}}$
			f = 10 kHz	12	17		12	17		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu\text{V}$
			f = 0.1 Hz to 10 Hz	0.6			0.6			
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			$\text{fA}/\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	25°C	0.013%			0.013%			
$B_1$	Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C	2.8			2.8			MHz
$\phi_m$	Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	56°			56°			

† Full range is 0°C to 70°C.



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**TLE2072C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072C			TLE2072AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50 \Omega$	25°C	1.1	6		0.7	3.5	mV		
		Full range			7.8		5.3			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2.4	25		2.4	25	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0, \text{See Figure 4}$	25°C	6	100		6	100	pA		
		Full range			1.4		1.4	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range			5		5	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.9			15 to -10.9				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu A$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.6			13.6				
	$I_O = -2 \text{ mA}$	25°C	13.5	13.9		13.5	13.9			
		Full range	13.4			13.4				
$I_O = -20 \text{ mA}$	25°C	11.5	12.3		11.5	12.3				
	Full range	11.5			11.5					
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu A$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.7			-13.7				
	$I_O = 2 \text{ mA}$	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.4			-13.4				
$I_O = 20 \text{ mA}$	25°C	-11.5	-12.4		-11.5	-12.4				
	Full range	-11.5			-11.5					
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$	$R_L = 600 \Omega$	25°C	80	96		80	96	dB	
			Full range	79			79			
		$R_L = 2 \text{ k}\Omega$	25°C	90	109		90	109		
			Full range	89			89			
		$R_L = 10 \text{ k}\Omega$	25°C	95	118		95	118		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0, \text{See Figure 5}$	Common mode	25°C	7.5			7.5			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1 \text{ MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}, V_O = 0, R_S = 50 \Omega$	25°C	80	98		80	98	dB		
		Full range	79			79				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5 \text{ V to } \pm 15 \text{ V}, V_O = 0, R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	81			81				

† Full range is 0°C to 70°C.



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**TLE2072C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$	TLE2072C			TLE2072AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load	25°C	2.7	3.1	3.9	2.7	3.1	3.9	mA
			Full range	3.9			3.9			
$a_x$	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1\text{ V}$	-30	-45	-30	-45	mA	
				$V_{ID} = -1\text{ V}$	30	48	30	48		

**TLE2072C operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072C			TLE2072AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+	Positive slew rate	$V_{O(PP)} = 10\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	28	40	28	40	V/ $\mu$ s		
			Full range	25			25			
SR-	Negative slew rate	$V_{O(PP)} = 10\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	30	45	30	45	V/ $\mu$ s		
			Full range	25			25			
$t_s$	Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.4			0.4			$\mu$ s
			To 1 mV	1.5			1.5			
$V_n$	Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz	48	85	48	85	nV/ $\sqrt{\text{Hz}}$		
			f = 10 kHz	12	17	12	17			
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu$ V
			f = 0.1 Hz to 10 Hz	0.6			0.6			
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 20\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	25°C	0.008%			0.008%			
$B_1$	Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	8	10	8	10	MHz		
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 20\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C	478	637	478	637	kHz		
$\phi_m$	Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	57°			57°			

† Full range is 0°C to 70°C.

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**TLE2072I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072I			TLE2072AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0,$ $R_S = 50\ \Omega$	25°C	0.9	6		0.65	3.5	mV		
		Full range			9.1		6.4			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2.4	25		2.4	25	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range			5		5	nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range			10		10	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.8			5 to -0.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.7			3.7				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.4			3.4				
	$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3			
		Full range	1.5			1.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.7			-3.7				
	$I_O = 2\ \text{mA}$	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.4			-3.4				
	$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4			
		Full range	-1.5			-1.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	79			79			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	89			89			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	11			11			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0, R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V},$ $V_O = 0, R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

† Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .





**TLE207x, TLE207xA**  
**EXCALIBUR LOW-NOISE HIGH-SPEED**  
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**TLE2072I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$	TLE2072I			TLE2072AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load	25°C	2.7	2.9	3.9	2.7	2.9	3.9	mA
			Full range	3.9			3.9			
$a_x$	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	$V_{ID} = 1\text{ V}$	-35			-35			mA
			$V_{ID} = -1\text{ V}$	45			45			

**TLE2072I operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2072I			TLE2072AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+	Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	35			35			V/ $\mu\text{s}$
			Full range	20			20			
SR-	Negative slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	38			38			V/ $\mu\text{s}$
			Full range	20			20			
$t_s$	Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.25			0.25			$\mu\text{s}$
			To 1 mV	0.4			0.4			
$V_n$	Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz	48	85		48	85	nV/ $\sqrt{\text{Hz}}$	
			f = 10 kHz	12	17		12	17		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu\text{V}$
			f = 0.1 Hz to 10 Hz	0.6			0.6			
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	$A_{VD} = 10$ , $R_L = 2\text{ k}\Omega$ , 25°C	0.013%			0.013%			
$B_1$	Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C	2.8			2.8			MHz
$\phi_m$	Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	56°			56°			

$^\dagger$  Full range is 40°C to 85°C.



# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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**TLE2072I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072I			TLE2072AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega,$ $V_O = 0,$	25°C	1.1	6		0.7	3.5	mV		
		Full range			9.1		6.4			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2.4	25		2.4	25	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	6	100		6	100	pA		
		Full range			5		5	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range			10		10	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.8			15 to -10.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu A$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.7			13.7				
	$I_O = -2$ mA	25°C	13.5	13.9		13.5	13.9			
		Full range	13.4			13.4				
	$I_O = -20$ mA	25°C	11.5	12.3		11.5	12.3			
		Full range	11.5			11.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu A$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.7			-13.7				
	$I_O = 2$ mA	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.4			-13.4				
	$I_O = 20$ mA	25°C	-11.5	-12.4		-11.5	-12.4			
		Full range	-11.5			-11.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10$ V	$R_L = 600 \Omega$	25°C	80	96		80	96	dB	
			Full range	79			79			
		$R_L = 2$ k $\Omega$	25°C	90	109		90	109		
			Full range	89			89			
		$R_L = 10$ k $\Omega$	25°C	95	118		95	118		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	7.5			7.5			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1$ MHz	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	80	98		80	98	dB		
		Full range	79			79				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

† Full range is  $-40^\circ C$  to  $85^\circ C$ .



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**TLE2072I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$  (unless otherwise noted)**  
**(continued)**

PARAMETER	TEST CONDITIONS	$T_A$	TLE2072I			TLE2072AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load	25°C	2.7	3.1	3.9	2.7	3.1	3.9	mA
			Full range	3.9			3.9			
$a_x$	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1\text{ V}$	-30	-45	-30	-45	mA	
				$V_{ID} = -1\text{ V}$	30	48	30	48		

**TLE2072I operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072I			TLE2072AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)} = \pm 10\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	28	40	28	40	V/ $\mu$ s	
			Full range	22			22		
SR-	Negative slew rate	$V_{O(PP)} = \pm 10\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	30	45	30	45	V/ $\mu$ s	
			Full range	22			22		
$t_s$	Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	25°C	To 10 mV	0.4		0.4		$\mu$ s
				To 1 mV	1.5		1.5		
$V_n$	Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	25°C	f = 10 Hz	48	85	48	85	nV/ $\sqrt{\text{Hz}}$
				f = 10 kHz	12	17	12	17	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	25°C	f = 0 Hz to 10 kHz	6		6		$\mu$ V
				f = 0.1 Hz to 10 Hz	0.6		0.6		
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8		2.8		fA/ $\sqrt{\text{Hz}}$	
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 20\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	25°C	0.008%		0.008%			
$B_1$	Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	8	10	8	10	MHz	
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 20\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C	478	637	478	637	kHz	
$\phi_m$	Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	57°		57°			

† Full range is -40°C to 85°C.



# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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**TLE2072M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072M			TLE2072AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0,$ $R_S = 50\ \Omega,$	25°C	0.9	6		0.65	3.5	mV		
		Full range			10.5		8			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2.3	25*		2.3	25*	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range			20		20	nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range			60		60	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.8			5 to -0.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.6			3.6				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.3			3.3				
$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3				
	Full range	1.4			1.4					
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.6			-3.6				
	$I_O = 2\ \text{mA}$	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.3			-3.3				
$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4				
	Full range	-1.4			-1.4					
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	78			78			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	88			88			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	93			93			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0,$ See Figure 5	Common mode	25°C	11			11			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				

\*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .



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**TLE2072M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2072M			TLE2072AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\text{ V}$ to $\pm 15\text{ V}$ , $V_O = 0$ , $R_S = 50\ \Omega$	Full range			80			dB
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load	25°C			2.7 2.9 3.6			mA
			Full range			3.6			
$a_x$	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	$V_{ID} = 1\text{ V}$			-35			mA
			$V_{ID} = -1\text{ V}$			45			

$^\dagger$  Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**TLE2072M operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2072M			TLE2072AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$SR_+$	Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C			35			$\text{V}/\mu\text{s}$
			Full range			18*			
$SR_-$	Negative slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C			38			$\text{V}/\mu\text{s}$
			Full range			18*			
$t_s$	Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV			0.25			$\mu\text{s}$
			To 1 mV			0.4			
$V_n$	Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz			48 85*			$\text{nV}/\sqrt{\text{Hz}}$
			f = 10 kHz			12 17*			
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz			6			$\mu\text{V}$
			f = 0.1 Hz to 10 Hz			0.6			
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C			2.8			$\text{fA}/\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	25°C			0.013%			
$B_1$	Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C			9.4			MHz
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C			2.8			MHz
$\phi_m$	Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C			56°			

\*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

$^\dagger$  Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .



# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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**TLE2072M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072M			TLE2072AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50 \Omega$	25°C	1.1	6		0.7	3.5	mV		
		Full range			10.5		8			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	2.4	25*		2.4	25*	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0, \text{See Figure 4}$	25°C	6	100		6	100	pA		
		Full range			20		20	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range			60		60	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.8			15 to -10.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu A$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.6			13.6				
	$I_O = -2 \text{ mA}$	25°C	13.5	13.9		13.5	13.9			
		Full range	13.3			13.3				
$I_O = -20 \text{ mA}$	25°C	11.5	12.3		11.5	12.3				
	Full range	11.4			11.4					
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu A$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.6			-13.6				
	$I_O = 2 \text{ mA}$	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.3			-13.3				
$I_O = 20 \text{ mA}$	25°C	-11.5	-12.4		-11.5	-12.4				
	Full range	-11.4			-11.4					
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$	$R_L = 600 \Omega$	25°C	80	96		80	96	dB	
			Full range	78			78			
		$R_L = 2 \text{ k}\Omega$	25°C	90	109		90	109		
			Full range	89			89			
		$R_L = 10 \text{ k}\Omega$	25°C	95	118		95	118		
			Full range	93			93			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	$V_{IC} = 0, \text{See Figure 5}$	Common mode	25°C	7.5			7.5			pF
		Differential	25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1 \text{ MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}, V_O = 0, R_S = 50 \Omega$	25°C	80	98		80	98	dB		
		Full range	78			78				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5 \text{ V to } \pm 15 \text{ V}, V_O = 0, R_S = 50 \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

\*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

† Full range is  $-55^\circ C$  to  $125^\circ C$ .



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**TLE2072M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072M			TLE2072AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load	25°C	2.7	3.1	3.6	2.7	3.1	3.6	mA
			Full range	3.6			3.6			
$a_x$	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2$ k $\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1$ V	-30	-45	-30	-45	mA	
				$V_{ID} = -1$ V	30	48	30	48		

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**TLE2072M operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2072M			TLE2072AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)} = 10$ V, $R_L = 2$ k $\Omega$ , $C_L = 100$ pF, See Figure 1	25°C	28	40		28	40	V/ $\mu$ s
			Full range	20			20		
SR-	Negative slew rate	$V_{O(PP)} = 10$ V, $R_L = 2$ k $\Omega$ , $C_L = 100$ pF, See Figure 1	25°C	30	45		30	45	V/ $\mu$ s
			Full range	20			20		
$t_s$	Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	25°C	To 10 mV	0.4		0.4		$\mu$ s
				To 1 mV	1.5		1.5		
$V_n$	Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz	48	85*	48	85*	nV/ $\sqrt{\text{Hz}}$
				f = 10 kHz	12	17*	12	17*	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz to 10 kHz	6		6		$\mu$ V
				f = 0.1 Hz to 10 Hz	0.6		0.6		
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8		fA/ $\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 20$ V, f = 1 kHz, $R_S = 25$ $\Omega$	25°C	0.008%			0.008%		
$B_1$	Unity-gain bandwidth	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	8*	10		8*	10	MHz
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 20$ V, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF	25°C	478*	637		478*	637	kHz
$\phi_m$	Phase margin at unity gain	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	57°			57°		

\*On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .



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**TLE2072Y electrical characteristics at  $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$**

PARAMETER		TEST CONDITIONS		TLE2072Y			UNIT
				MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$V_{IC} = 0$ , $V_O = 0$ , $R_S = 50\ \Omega$		1.1	6		mV
$I_{IO}$	Input offset current	$V_{IC} = 0$ , $V_O = 0$ , See Figure 4		6	100		pA
$I_{IB}$	Input bias current			20	175		pA
$V_{ICR}$	Common-mode input voltage range	$R_S = 50\ \Omega$		15 to -11	15 to 11.9		V
$V_{OM+}$	Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$		13.8	14.1		V
		$I_O = -2\ \text{mA}$		13.5	13.9		
		$I_O = -20\ \text{mA}$		11.5	12.3		
$V_{OM-}$	Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$		-13.8	-14.2		V
		$I_O = 2\ \text{mA}$		-13.5	-14		
		$I_O = 20\ \text{mA}$		-11.5	-12.4		
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 10\ \text{V}$	$R_L = 600\ \Omega$	80	96		dB
			$R_L = 2\ \text{k}\Omega$	90	109		
			$R_L = 10\ \text{k}\Omega$	95	118		
$r_i$	Input resistance	$V_{IC} = 0$		10 <sup>12</sup>			$\Omega$
$c_i$	Input capacitance	$V_{IC} = 0$ , See Figure 5	Common mode	7.5			pF
			Differential	2.5			
$Z_o$	Open-loop output impedance	$f = 1\ \text{MHz}$		80			$\Omega$
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$ , $V_O = 0$ , $R_S = 50\ \Omega$		80	98		dB
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V}$ , $R_S = 50\ \Omega$ , $V_O = 0$ ,		82	99		dB
$I_{CC}$	Supply current (both channels)	$V_O = 0$ , No load		2.7	3.1	3.9	mA
$I_{OS}$	Short-circuit output current	$V_O = 0$		$V_{ID} = 1\ \text{V}$	-30	-45	mA
				$V_{ID} = -1\ \text{V}$	30	48	





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**TLE2074C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074C			TLE2074AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0,$ $R_S = 50\ \Omega$	25°C	-1.6	5		-0.5	3	mV		
		Full range			7.1		5.1			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	10.1	30		10.1	30	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	15	100		15	100	pA		
		Full range		1400		1400				
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range		5000		5000				
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.9			5 to -0.9				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.7			3.7				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.4			3.4				
	$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3			
		Full range	1.5			1.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.7			-3.7				
	$I_O = 2\ \text{mA}$	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.4			-3.4				
	$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4			
		Full range	-1.5			-1.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	79			79			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	89			89			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	Common mode	$V_{IC} = 0,$ See Figure 5	25°C	11			11			pF
	Differential		25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0, R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V},$ $V_O = 0, R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

† Full range is 0°C to 70°C.

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**TLE2074C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  V (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074C			TLE2074AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$	Supply current (four amplifiers) $V_O = 0$ , No load	25°C	5.2	6.3	7.5	5.2	6.3	7.5	mA
		Full range	7.5			7.5			
	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2$ k $\Omega$	120			120			dB
$I_{OS}$	Short-circuit output current $V_O = 0$	$V_{ID} = 1$ V	-35			-35			mA
		$V_{ID} = -1$ V	45			45			

† Full range is 0°C to 70°C.

**TLE2074C operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074C			TLE2074AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	25°C	35			35			V/ $\mu$ s
		Full range	22			22			
SR-	Negative slew rate	25°C	38			38			V/ $\mu$ s
		Full range	22			22			
$t_s$	Settling time	25°C	$A_{VD} = -1$ , 2-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	To 10 mV	0.25		0.25		$\mu$ s
				To 1 mV	0.4		0.4		
$V_n$	Equivalent input noise voltage	25°C	$R_S = 20$ $\Omega$ , See Figure 3	f = 10 Hz	48	85	48	85	nV/ $\sqrt{Hz}$
				f = 10 kHz	12	17	12	17	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	25°C	$R_S = 20$ $\Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6		6		$\mu$ V
				f = 0.1 Hz to 10 Hz	0.6		0.6		
$I_n$	Equivalent input noise current	25°C	$V_{IC} = 0$ , f = 10 kHz	2.8		2.8		fA/ $\sqrt{Hz}$	
THD + N	Total harmonic distortion plus noise	25°C	$V_{O(PP)} = 5$ V, f = 1 kHz, $R_S = 25$ $\Omega$	$A_{VD} = 10$ , $R_L = 2$ k $\Omega$ ,	0.013%		0.013%		
$B_1$	Unity-gain bandwidth	25°C	$V_I = 10$ mV, $C_L = 25$ pF,	$R_L = 2$ k $\Omega$ , See Figure 2	9.4		9.4		MHz
$B_{OM}$	Maximum output-swing bandwidth	25°C	$V_{O(PP)} = 4$ V, $R_L = 2$ k $\Omega$ ,	$A_{VD} = -1$ , $C_L = 25$ pF	2.8		2.8		MHz
$\phi_m$	Phase margin at unity gain	25°C	$V_I = 10$ mV, $C_L = 25$ pF,	$R_L = 2$ k $\Omega$ , See Figure 2	56°		56°		

† Full range is 0°C to 70°C.



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**TLE2074C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074C			TLE2074AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega$ $V_O = 0,$	25°C	-1.6	5		-0.5	3	mV	
		Full range			7.1		5.1		
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	10.1	30		10.1	30	$\mu V/^\circ C$	
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	15	100		15	100	pA	
		Full range			1400		1400		
$I_{IB}$ Input bias current		25°C	25	175		25	175	pA	
		Full range			5000		5000		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V	
		Full range	15 to -10.9			15 to -10.9			
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu A$	25°C	13.8	14.1		13.8	14.1	V	
		Full range	13.7			13.7			
	$I_O = -2$ mA	25°C	13.5	13.9		13.5	13.9		
		Full range	13.4			13.4			
	$I_O = -20$ mA	25°C	11.5	12.3		11.5	12.3		
		Full range	11.5			11.5			
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu A$	25°C	-13.8	-14.2		-13.8	-14.2	V	
		Full range	-13.7			-13.7			
	$I_O = 2$ mA	25°C	-13.7	-14		-13.7	-14		
		Full range	-13.6			-13.6			
	$I_O = 20$ mA	25°C	-11.5	-12.4		-11.5	-12.4		
		Full range	-11.5			-11.5			
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10$ V	$R_L = 600 \Omega$	25°C	80	96		80	96	dB
			Full range	79			79		
		$R_L = 2$ k $\Omega$	25°C	90	109		90	109	
			Full range	89			89		
		$R_L = 10$ k $\Omega$	25°C	95	118		95	118	
			Full range	94			94		
$r_i$ Input resistance	$V_{IC} = 0$	25°C		$10^{12}$		$10^{12}$	$\Omega$		
$c_i$ Input capacitance	Common mode	$V_{IC} = 0,$ See Figure 5	25°C		7.5		7.5	pF	
	Differential		25°C		2.5		2.5		
$z_o$ Open-loop output impedance	$f = 1$ MHz	25°C		80		80	$\Omega$		
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50 \Omega$	25°C	80	98		80	98	dB	
		Full range	79			79			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5$ V to $\pm 15$ V, $V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB	
		Full range	81			81			

† Full range is 0°C to 70°C.



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**TLE2074C electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074C			TLE2074AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current (four amplifiers)	$V_O = 0$ , No load	25°C	5.2	6.5	7.5	5.2	6.5	7.5	mA
		Full range	7.5			7.5			
Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1\text{ V}$	-30	-45		-30	-45		mA
		$V_{ID} = -1\text{ V}$	30	48		30	48		

$^\dagger$  Full range is 0°C to 70°C.

**TLE2074C operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074C			TLE2074AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+ Positive slew rate	$V_{O(PP)} = 10\text{ V}$ , $A_{VD} = -1$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , See Figure 1	25°C	25	40		25	40		V/ $\mu$ s	
		Full range	22			22				
SR- Negative slew rate		25°C	30	45		30	45		V/ $\mu$ s	
		Full range	25			25				
$t_s$ Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.4			0.4			$\mu$ s	
		To 1 mV	1.5			1.5				
$V_n$ Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz	48	85		48	85		nV/ $\sqrt{\text{Hz}}$	
		f = 10 kHz	12	17		12	17			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu$ V	
		f = 0.1 Hz to 10 Hz	0.6			0.6				
$I_n$ Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$	
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 20\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	$A_{VD} = 10$ , $R_L = 2\text{ k}\Omega$	25°C	0.008%			0.008%			
$B_1$ Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	8	10		8	10		MHz	
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 20\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 25\text{ pF}$	$A_{VD} = -1$	25°C	478	637		478	637		kHz
$\phi_m$ Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	57°			57°				

$^\dagger$  Full range is 0°C to 70°C.



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**TLE2074I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074I			TLE2074AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0,$ $R_S = 50\ \Omega$	25°C	-1.6	5		-0.5	3	mV		
		Full range			9		7			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	10.1	30		10.1	30	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	15	100		15	100	pA		
		Full range		5			5	nA		
$I_{IB}$ Input bias current		25°C	20	175		20	175	pA		
		Full range		10			10	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	5 to -1	5 to -1.9		5 to -1	5 to -1.9	V		
		Full range	5 to -0.8			5 to -0.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	3.8	4.1		3.8	4.1	V		
		Full range	3.7			3.7				
	$I_O = -2\ \text{mA}$	25°C	3.5	3.9		3.5	3.9			
		Full range	3.4			3.4				
$I_O = -20\ \text{mA}$	25°C	1.5	2.3		1.5	2.3				
	Full range	1.5			1.5					
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-3.8	-4.2		-3.8	-4.2	V		
		Full range	-3.7			-3.7				
	$I_O = 2\ \text{mA}$	25°C	-3.5	-4.1		-3.5	-4.1			
		Full range	-3.4			-3.4				
$I_O = 20\ \text{mA}$	25°C	-1.5	-2.4		-1.5	-2.4				
	Full range	-1.5			-1.5					
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91		80	91	dB	
			Full range	79			79			
		$R_L = 2\ \text{k}\Omega$	25°C	90	100		90	100		
			Full range	89			89			
		$R_L = 10\ \text{k}\Omega$	25°C	95	106		95	106		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	Common mode	$V_{IC} = 0,$ See Figure 5	25°C	11			11			pF
	Differential		25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR\text{min}},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	70	89		70	89	dB		
		Full range	68			68				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V}$ to $\pm 15\ \text{V},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TLE2074I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074I			TLE2074AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$I_{CC}$ Supply current (four amplifiers)	$V_O = 0$ , No load	25°C	5.2	6.3	7.5	5.2	6.3	7.5	mA
		Full range	7.5			7.5			
Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$ Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1\text{ V}$			-35			mA
			$V_{ID} = -1\text{ V}$			45			

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

**TLE2074I operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074I			TLE2074AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+ Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $C_L = 100\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 1	25°C	35			35			V/ $\mu\text{s}$	
		Full range	20			20				
SR- Negative slew rate		25°C	38			38			V/ $\mu\text{s}$	
		Full range	20			20				
$t_s$ Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	25°C	To 10 mV			0.25			$\mu\text{s}$	
			To 1 mV			0.4				
$V_n$ Equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	25°C	f = 10 Hz		48		85		nV/ $\sqrt{\text{Hz}}$	
			f = 10 kHz		12		17			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		25°C	f = 10 Hz to 10 kHz		6		6		$\mu\text{V}$	
			f = 0.1 Hz to 10 Hz		0.6		0.6			
$I_n$ Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			fA/ $\sqrt{\text{Hz}}$	
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	$A_{VD} = 10$ , $R_L = 2\text{ k}\Omega$	25°C	0.013%			0.013%			
$B_1$ Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$	$R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$	$A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C	2.8			2.8			MHz
$\phi_m$ Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$	$R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	56°			56°			

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TLE2074I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074I			TLE2074AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega$ $V_O = 0,$	25°C	-1.6	5		-0.5	3	mV		
		Full range			9		7			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	10.1	30		10.1	30	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0,$ $V_O = 0,$ See Figure 4	25°C	15	100		15	100	pA		
		Full range		5			5	nA		
$I_{IB}$ Input bias current		25°C	25	175		25	175	pA		
		Full range		10			10	nA		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V		
		Full range	15 to -10.8			15 to -10.8				
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$	25°C	13.8	14.1		13.8	14.1	V		
		Full range	13.7			13.7				
	$I_O = -2\ \text{mA}$	25°C	13.5	13.9		13.5	13.9			
		Full range	13.4			13.4				
	$I_O = -20\ \text{mA}$	25°C	11.5	12.3		11.5	12.3			
		Full range	11.5			11.5				
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$	25°C	-13.8	-14.2		-13.8	-14.2	V		
		Full range	-13.7			-13.7				
	$I_O = 2\ \text{mA}$	25°C	-13.5	-14		-13.5	-14			
		Full range	-13.4			-13.4				
	$I_O = 20\ \text{mA}$	25°C	-11.5	-12.4		-11.5	-12.4			
		Full range	-11.5			-11.5				
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	96		80	96	dB	
			Full range	79			79			
		$R_L = 2\ \text{k}\Omega$	25°C	90	109		90	109		
			Full range	89			89			
		$R_L = 10\ \text{k}\Omega$	25°C	95	118		95	118		
			Full range	94			94			
$r_i$ Input resistance	$V_{IC} = 0$	25°C	$10^{12}$			$10^{12}$			$\Omega$	
$c_i$ Input capacitance	Common mode	$V_{IC} = 0,$ See Figure 5	25°C	7.5			7.5			pF
	Differential		25°C	2.5			2.5			
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$	25°C	80			80			$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	80	98		80	98	dB		
		Full range	79			79				
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V to } \pm 15\ \text{V},$ $V_O = 0,$ $R_S = 50\ \Omega$	25°C	82	99		82	99	dB		
		Full range	80			80				

$^\dagger$  Full range is  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .



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**TLE2074I electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074I			TLE2074AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (four amplifiers)	$V_O = 0$ , No load	25°C	5.2	6.5	7.5	5.2	6.5	7.5	mA
			Full range	7.5			7.5			
	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2$ k $\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1$ V	-30	-45	-30	-45	mA	
				$V_{ID} = -1$ V	30	48	30	48		

† Full range is -40°C to 85°C.

**TLE2074I operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074I			TLE2074AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)} = \pm 10$ V, $A_{VD} = -1$ , $C_L = 100$ pF, $R_L = 2$ k $\Omega$ , See Figure 1	25°C	25	40	25	40	V/ $\mu$ s	
			Full range	19			19		
SR-	Negative slew rate	$V_{O(PP)} = \pm 10$ V, $A_{VD} = -1$ , $C_L = 100$ pF, $R_L = 2$ k $\Omega$ , See Figure 1	25°C	30	45	30	45	V/ $\mu$ s	
			Full range	22			22		
$t_s$	Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	25°C	To 10 mV	0.4		0.4		$\mu$ s
				To 1 mV	1.5		1.5		
$V_n$	Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz	48	85	48	85	nV/ $\sqrt{Hz}$
				f = 10 kHz	12	17	12	17	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz to 10 kHz	6		6		$\mu$ V
				f = 0.1 Hz to 10 Hz	0.6		0.6		
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8		2.8		fA/ $\sqrt{Hz}$	
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 20$ V, f = 1 kHz, $R_S = 25$ $\Omega$	25°C	0.008%		0.008%			
$B_1$	Unity-gain bandwidth	$V_I = 10$ mV, $C_L = 25$ pF, $R_L = 2$ k $\Omega$ , See Figure 2	25°C	8	10	8	10	MHz	
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 20$ V, $R_L = 2$ k $\Omega$ , $A_{VD} = -1$ , $C_L = 25$ pF	25°C	478	637	478	637	kHz	
$\phi_m$	Phase margin at unity gain	$V_I = 10$ mV, $C_L = 25$ pF, $R_L = 2$ k $\Omega$ , See Figure 2	25°C	57°		57°			

† Full range is -40°C to 85°C.





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**TLE2074M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074M			TLE2074AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega$	$V_O = 0,$	25°C	-1.6	5	-0.5	3	mV	
			Full range	10.5			8.5		
$\alpha_{VIO}$ Temperature coefficient of input offset voltage	$V_{IC} = 0,$ $R_S = 50\ \Omega$	$V_O = 0,$	25°C	10.1	30 <sup>‡</sup>	10.1	30 <sup>‡</sup>	$\mu\text{V}/^\circ\text{C}$	
Full range			10.1			30 <sup>‡</sup>			
$I_{IO}$ Input offset current	$V_{IC} = 0,$ See Figure 4	$V_O = 0,$	25°C	15	100	15	100	pA	
			Full range	20			20		
$I_{IB}$ Input bias current	$V_{IC} = 0,$ See Figure 4	$V_O = 0,$	25°C	20	175	20	175	pA	
			Full range	60			60		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$		25°C	5 to -1	5 to -1.9	5 to -1	5 to -1.9	V	
			Full range	5 to -0.8		5 to -0.8			
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200\ \mu\text{A}$		25°C	3.8	4.1	3.8	4.1	V	
			Full range	3.6			3.6		
	$I_O = -2\ \text{mA}$		25°C	3.5	3.9	3.5	3.9		
			Full range	3.3			3.3		
$I_O = -20\ \text{mA}$		25°C	1.5	2.3	1.5	2.3			
		Full range	1.4			1.4			
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200\ \mu\text{A}$		25°C	-3.8	-4.2	-3.8	-4.2	V	
			Full range	-3.6			-3.6		
	$I_O = 2\ \text{mA}$		25°C	-3.5	-4.1	-3.5	-4.1		
			Full range	-3.3			-3.3		
$I_O = 20\ \text{mA}$		25°C	-1.5	-2.4	-1.5	-2.4			
		Full range	-1.4			-1.4			
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 2.3\ \text{V}$	$R_L = 600\ \Omega$	25°C	80	91	80	91	dB	
			Full range	78			78		
		$R_L = 2\ \text{k}\Omega$	25°C	90	100	90	100		
			Full range	88			88		
		$R_L = 10\ \text{k}\Omega$	25°C	95	106	95	106		
			Full range	93			93		
$r_i$ Input resistance	$V_{IC} = 0$		25°C	$10^{12}$			$10^{12}$	$\Omega$	
$c_i$ Input capacitance	Common mode	$V_{IC} = 0,$ See Figure 5	25°C	11			11	pF	
	Differential		25°C	2.5			2.5		
$z_o$ Open-loop output impedance	$f = 1\ \text{MHz}$		25°C	80			80	$\Omega$	
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $V_O = 0,$ $R_S = 50\ \Omega$		25°C	70	89	70	89	dB	
			Full range	68			68		
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5\ \text{V}$ to $\pm 15\ \text{V},$ $V_O = 0,$ $R_S = 50\ \Omega$		25°C	82	99	82	99	dB	
			Full range	80			80		

<sup>†</sup> Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

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



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**TLE2074M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074M			TLE2074AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (four amplifiers)	$V_O = 0$ , No load	25°C	5.2	6.3	7.5	5.2	6.3	7.5	mA
			Full range	7.5			7.5			
	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2\text{ k}\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1\text{ V}$			-35			mA
				$V_{ID} = -1\text{ V}$			45			

$^\dagger$  Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**TLE2074M operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074M			TLE2074AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+	Positive slew rate	$V_{O(PP)} = \pm 2.3\text{ V}$ , $A_{VD} = -1$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , See Figure 1	25°C	35			35			$\text{V}/\mu\text{s}$
			Full range	18 $^\ddagger$			18 $^\ddagger$			
SR-	Negative slew rate		25°C	38			38			$\text{V}/\mu\text{s}$
			Full range	18 $^\ddagger$			18 $^\ddagger$			
$t_s$	Settling time	$A_{VD} = -1$ , 2-V step, $R_L = 1\text{ k}\Omega$ , $C_L = 100\text{ pF}$	To 10 mV	0.25			0.25			$\mu\text{s}$
			To 1 mV	0.4			0.4			
$V_n$	Equivalent input noise voltage		f = 10 Hz	48	85 $^\ddagger$		48	85 $^\ddagger$		$\text{nV}/\sqrt{\text{Hz}}$
			f = 10 kHz	12	17 $^\ddagger$		12	17 $^\ddagger$		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20\ \Omega$ , See Figure 3	f = 10 Hz to 10 kHz	6			6			$\mu\text{V}$
			f = 0.1 Hz to 10 Hz	0.6			0.6			
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8			2.8			$\text{fA}/\sqrt{\text{Hz}}$
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 5\text{ V}$ , f = 1 kHz, $R_S = 25\ \Omega$	25°C	0.013%			0.013%			
$B_1$	Unity-gain bandwidth	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 4\text{ V}$ , $R_L = 2\text{ k}\Omega$ , $A_{VD} = -1$ , $C_L = 25\text{ pF}$	25°C	2.8			2.8			MHz
$f_m$	Phase margin at unity gain	$V_I = 10\text{ mV}$ , $C_L = 25\text{ pF}$ , $R_L = 2\text{ k}\Omega$ , See Figure 2	25°C	56°			56°			

$^\dagger$  Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

$^\ddagger$  On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.



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**TLE2074M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	TLE2074M			TLE2074AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0,$ $R_S = 50 \Omega$	25°C	-1.6	5		-0.5	3	mV	
		Full range			10.5		8.5		
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	10.1	30 <sup>‡</sup>		10.1	30 <sup>‡</sup>	$\mu\text{V}/^\circ\text{C}$	
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	15	100		15	100	pA	
		Full range		20		20		nA	
$I_{IB}$ Input bias current		25°C	25	175		25	175	pA	
		Full range		60		60		nA	
$V_{ICR}$ Common-mode input voltage range	$R_S = 50 \Omega$	25°C	15 to -11	15 to -11.9		15 to -11	15 to -11.9	V	
		Full range	15 to -10.8			15 to -10.8			
$V_{OM+}$ Maximum positive peak output voltage swing	$I_O = -200 \mu\text{A}$	25°C	13.8	14.1		13.8	14.1	V	
		Full range	13.6			13.6			
	$I_O = -2 \text{ mA}$	25°C	13.5	13.9		13.5	13.9		
		Full range	13.3			13.3			
	$I_O = -20 \text{ mA}$	25°C	11.5	12.3		11.5	12.3		
		Full range	11.4			11.4			
$V_{OM-}$ Maximum negative peak output voltage swing	$I_O = 200 \mu\text{A}$	25°C	-13.8	-14.2		-13.8	-14.2	V	
		Full range	-13.6			-13.6			
	$I_O = 2 \text{ mA}$	25°C	-13.5	-14		-13.5	-14		
		Full range	-13.3			-13.3			
	$I_O = 20 \text{ mA}$	25°C	-11.5	-12.4		-11.5	-12.4		
		Full range	-11.4			-11.4			
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$	$R_L = 600 \Omega$	25°C	80	96		80	96	dB
			Full range	78			78		
		$R_L = 2 \text{ k}\Omega$	25°C	90	109		90	109	
			Full range	88			88		
		$R_L = 10 \text{ k}\Omega$	25°C	95	118		95	118	
			Full range	93			93		
$r_i$ Input resistance	$V_{IC} = 0$	25°C		$10^{12}$		$10^{12}$	$\Omega$		
$c_i$ Input capacitance	Common mode	$V_{IC} = 0,$ See Figure 5	25°C	7.5		7.5	pF		
	Differential		25°C	2.5		2.5			
$z_o$ Open-loop output impedance	$f = 1 \text{ MHz}$	25°C		80		80	$\Omega$		
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}, V_O = 0,$ $R_S = 50 \Omega$	25°C	80	98		80	98	dB	
		Full range	78			78			
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 5 \text{ V to } \pm 15 \text{ V}, V_O = 0,$ $R_S = 50 \Omega$	25°C	82	99		82	99	dB	
		Full range	80			80			

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

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



# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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**TLE2074M electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V (unless otherwise noted) (continued)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074M			TLE2074AM			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CC}$	Supply current (four amplifiers)	$V_O = 0$ , No load	25°C	5.2	6.5	7.5	5.2	6.5	7.5	mA
			Full range	7.5			7.5			
	Crosstalk attenuation	$V_{IC} = 0$ , $R_L = 2$ k $\Omega$	25°C	120			120			dB
$I_{OS}$	Short-circuit output current	$V_O = 0$	25°C	$V_{ID} = 1$ V	-30	-45	-30	-45	mA	
				$V_{ID} = -1$ V	30	48	30	48		

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**TLE2074M operating characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  V**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2074M			TLE2074AM			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)} = 10$ V, $R_L = 2$ k $\Omega$ , See Figure 1	25°C	25	40		25	40	V/ $\mu$ s
				Full range	17			17	
SR-	Negative slew rate	$V_{O(PP)} = 10$ V, $R_L = 2$ k $\Omega$ , See Figure 1	25°C	30	45		30	45	V/ $\mu$ s
				Full range	20			20	
$t_s$	Settling time	$A_{VD} = -1$ , 10-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	25°C	To 10 mV	0.4		0.4		$\mu$ s
				To 1 mV	1.5		1.5		
$V_n$	Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz	48	85‡	48	85‡	nV/ $\sqrt{\text{Hz}}$
				f = 10 kHz	12	17‡	12	17‡	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz to 10 kHz	6		6		$\mu$ V
				f = 0.1 Hz to 10 Hz	0.6		0.6		
$I_n$	Equivalent input noise current	$V_{IC} = 0$ , f = 10 kHz	25°C	2.8		2.8		fA/ $\sqrt{\text{Hz}}$	
THD + N	Total harmonic distortion plus noise	$V_{O(PP)} = 20$ V, f = 1 kHz, $R_S = 25$ $\Omega$	25°C	0.008%		0.008%			
$B_1$	Unity-gain bandwidth	$V_I = 10$ mV, $C_L = 25$ pF, $R_L = 2$ k $\Omega$ , See Figure 2	25°C	8‡	10	8‡	10	MHz	
$B_{OM}$	Maximum output-swing bandwidth	$V_{O(PP)} = 20$ V, $R_L = 2$ k $\Omega$ , $A_{VD} = -1$ , $C_L = 25$ pF	25°C	478‡	637	478‡	637	kHz	
$\phi_m$	Phase margin at unity gain	$V_I = 10$ mV, $C_L = 25$ pF, $R_L = 2$ k $\Omega$ , See Figure 2	25°C	57°		57°			

† Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

‡ On products compliant to MIL-PRF-38535, Class B, this parameter is not production tested.



**TLE207x, TLE207xA**  
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**TLE2074Y electrical characteristics at  $V_{CC\pm} = \pm 15$  V,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

PARAMETER		TEST CONDITIONS		TLE2074Y			UNIT
				MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$V_{IC} = 0,$ $R_S = 50 \Omega$	$V_O = 0,$			5	mV
$I_{IO}$	Input offset current	$V_{IC} = 0,$	$V_O = 0,$		15	100	pA
$I_{IB}$	Input bias current	See Figure 4			25	175	
$V_{ICR}$	Common-mode input voltage range	$R_S = 50 \Omega$		15 to -11	15 to 11.9		V
$V_{OM+}$	Maximum positive peak output voltage swing	$I_O = -200 \mu\text{A}$		13.8	14.1		V
		$I_O = -2 \text{ mA}$		13.5	13.9		
		$I_O = -20 \text{ mA}$		11.5	12.3		
$V_{OM-}$	Maximum negative peak output voltage swing	$I_O = 200 \mu\text{A}$		-13.8	-14.2		V
		$I_O = 2 \text{ mA}$		-13.5	-14		
		$I_O = 20 \text{ mA}$		-11.5	-12.4		
$A_{VD}$	Large-signal differential voltage amplification	$V_O = \pm 10 \text{ V}$		$R_L = 600 \Omega$	80	96	dB
				$R_L = 2 \text{ k}\Omega$	90	109	
				$R_L = 10 \text{ k}\Omega$	95	118	
$r_i$	Input resistance	$V_{IC} = 0$		$10^{12}$			$\Omega$
$c_i$	Input capacitance	Common mode	$V_O = 0,$	See Figure 5	7.5		pF
		Differential			2.5		
$z_o$	Open-loop output impedance	$f = 1 \text{ MHz}$		80			$\Omega$
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICRmin},$ $R_S = 50 \Omega$	$V_O = 0,$	80	98		dB
$k_{SVR}$	Supply-voltage rejection ratio ( $\Delta V_{CC\pm}/\Delta V_{IO}$ )	$V_{CC\pm} = \pm 5 \text{ V to } \pm 15 \text{ V},$ $V_O = 0,$ $R_S = 50 \Omega$		82	99		dB
$I_{CC}$	Supply current (four amplifiers)	$V_O = 0,$	No load	5.2	6.5	7.5	mA
$I_{OS}$	Short-circuit output current	$V_O = 0$		$V_{ID} = 1 \text{ V}$	-30	-45	mA
				$V_{ID} = -1 \text{ V}$	30	48	



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## PARAMETER MEASUREMENT INFORMATION



† Includes fixture capacitance

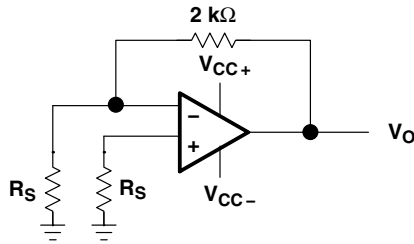
**Figure 1. Slew-Rate Test Circuit**



† Includes fixture capacitance

**Figure 2. Unity-Gain Bandwidth and Phase-Margin Test Circuit**

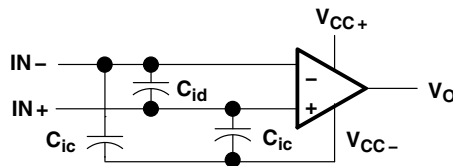
**PARAMETER MEASUREMENT INFORMATION**



**Figure 3. Noise-Voltage Test Circuit**



**Figure 4. Input-Bias and Offset-Current Test Circuit**



**Figure 5. Internal Input Capacitance**

**typical values**

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

**input bias and offset current**

At the picoampere bias current level typical of the TLE207x and TLE207xA, accurate measurement of the bias current becomes difficult. Not only does this measurement require a picoammeter but test socket leakages can easily exceed the actual device bias currents. To accurately measure these small currents, Texas Instruments uses a two-step process. The socket leakage is measured using picoammeters with bias voltages applied but with no device in the socket. The device is then inserted in the socket and a second test is performed that measures both the socket leakage and the device input bias current. The two measurements are then subtracted algebraically to determine the bias current of the device.

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**TYPICAL CHARACTERISTICS**

**Table of Graphs**

			<b>FIGURE</b>
$V_{IO}$	Input offset voltage	Distribution	6, 7, 8
$\alpha_{VIO}$	Temperature coefficient of input offset voltage	Distribution	9, 10, 11
$I_{IO}$	Input offset current	vs Free-air temperature	12, 13
$I_{IB}$	Input bias current	vs Free-air temperature vs Total supply voltage	12, 13 14
$V_{ICR}$	Common-mode input voltage range	vs Free-air temperature	15
$V_O$	Output voltage	vs Differential input voltage	16, 17
$V_{OM+}$	Maximum positive peak output voltage	vs Output current	18
$V_{OM-}$	Maximum negative peak output voltage	vs Output current	19
$V_{OM}$	Maximum peak output voltage	vs Free-air temperature vs Supply voltage	20, 21 22
$V_{O(PP)}$	Maximum peak-to-peak output voltage	vs Frequency	23
$V_O$	Output voltage	vs Settling time	24
$A_{VD}$	Large-signal differential voltage amplification	vs Load resistance vs Free-air temperature	25 26, 27
$A_{VD}$	Small-signal differential voltage amplification	vs Frequency	28, 29
CMRR	Common-mode rejection ratio	vs Frequency vs Free-air temperature	30 31
$k_{SVR}$	Supply-voltage rejection ratio	vs Frequency vs Free-air temperature	32 33
$I_{CC}$	Supply current	vs Supply voltage vs Free-air temperature vs Differential input voltage	34, 35, 36 37, 38, 39 40 – 45
$I_{OS}$	Short-circuit output current	vs Supply voltage vs Elapsed time vs Free-air temperature	46 47 48
SR	Slew rate	vs Free-air temperature vs Load resistance vs Differential input voltage	49, 50 51 52
$V_n$	Equivalent Input noise voltage (spectral density)	vs Frequency	53
$V_n$	Input referred noise voltage	vs Noise bandwidth Over a 10-second time interval	54 55
	Third-octave spectral noise density	vs Frequency bands	56
THD + N	Total harmonic distortion plus noise	vs Frequency	57, 58
$B_1$	Unity-gain bandwidth	vs Load capacitance	59
	Gain-bandwidth product	vs Free-air temperature vs Supply voltage	60 61
	Gain margin	vs Load capacitance	62
$\phi_m$	Phase margin	vs Free-air temperature vs Supply voltage vs Load capacitance	63 64 65
	Phase shift	vs Frequency	28, 29
	Noninverting large-signal pulse response	vs Time	66
	Small-signal pulse response	vs Time	67
$z_o$	Closed-loop output impedance	vs Frequency	68
	Crosstalk attenuation	vs Frequency	69





**TYPICAL CHARACTERISTICS**

**DISTRIBUTION OF TLE2071  
 INPUT OFFSET VOLTAGE**



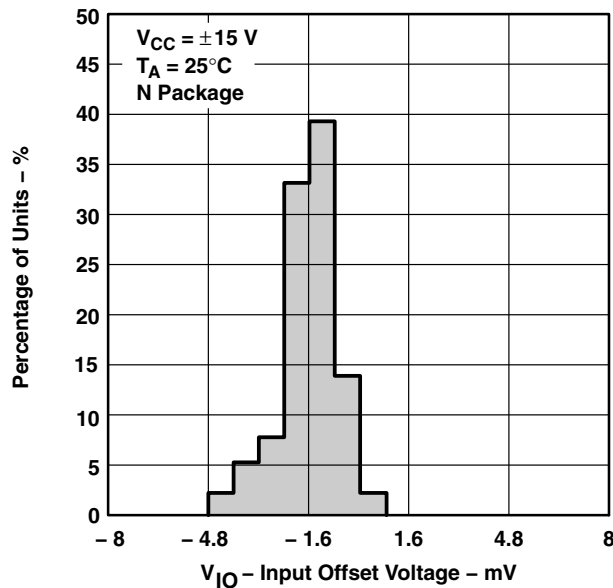
**Figure 6**

**DISTRIBUTION OF TLE2072  
 INPUT OFFSET VOLTAGE**



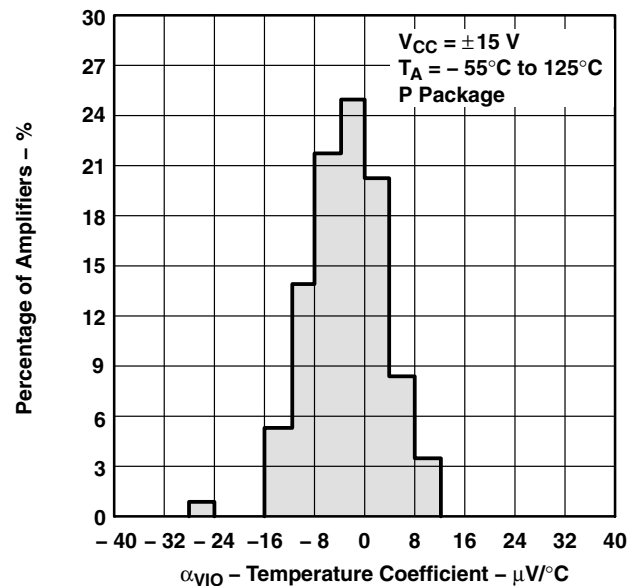
**Figure 7**

**DISTRIBUTION OF TLE2074  
 INPUT OFFSET VOLTAGE**



**Figure 8**

**DISTRIBUTION OF TLE2071 INPUT OFFSET  
 VOLTAGE TEMPERATURE COEFFICIENT**



**Figure 9**

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## TYPICAL CHARACTERISTICS

**DISTRIBUTION OF TLE2072 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT**



**Figure 10**

**DISTRIBUTION OF TLE2074 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT**



**Figure 11**

**INPUT BIAS CURRENT AND INPUT OFFSET CURRENT† vs FREE-AIR TEMPERATURE**



**Figure 12**

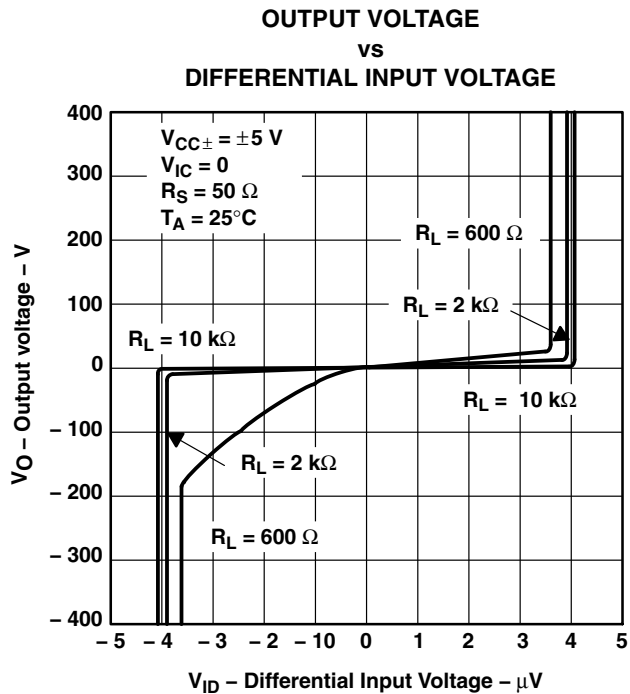
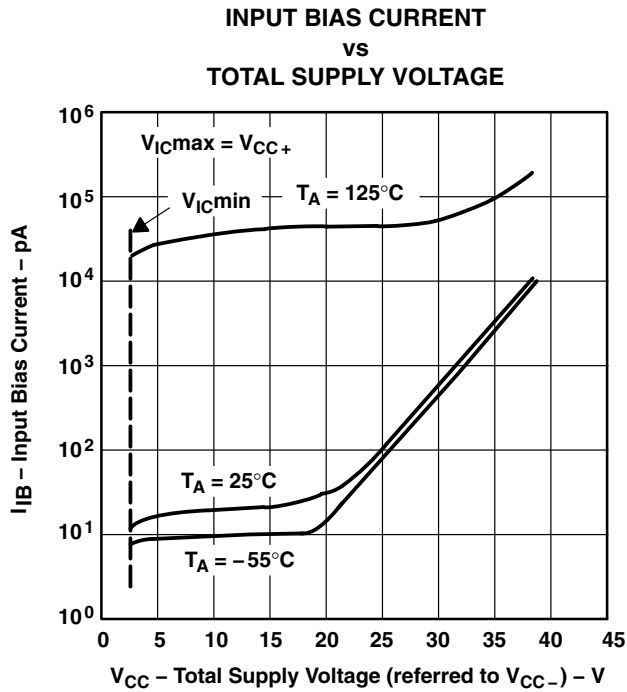
**INPUT BIAS CURRENT AND INPUT OFFSET CURRENT† vs FREE-AIR TEMPERATURE**



**Figure 13**

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

**TYPICAL CHARACTERISTICS**



† 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

MAXIMUM POSITIVE PEAK OUTPUT VOLTAGE†  
vs  
OUTPUT CURRENT



Figure 18

MAXIMUM NEGATIVE PEAK OUTPUT VOLTAGE†  
vs  
OUTPUT CURRENT



Figure 19

MAXIMUM PEAK OUTPUT VOLTAGE†  
vs  
FREE-AIR TEMPERATURE



Figure 20

MAXIMUM PEAK OUTPUT VOLTAGE†  
vs  
FREE-AIR TEMPERATURE



Figure 21

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

**TYPICAL CHARACTERISTICS**

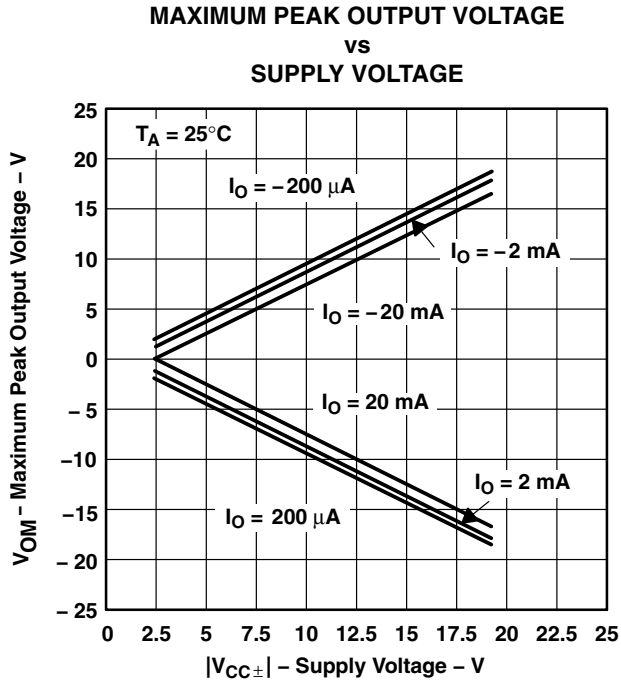


Figure 22

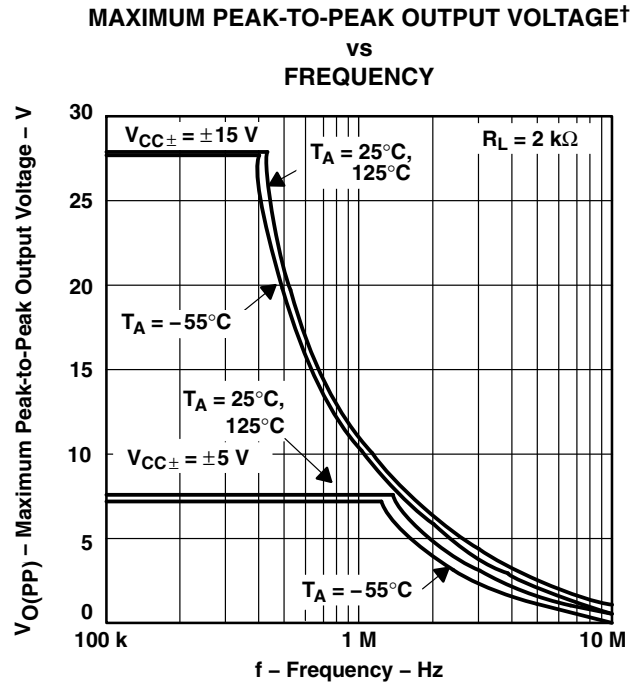


Figure 23

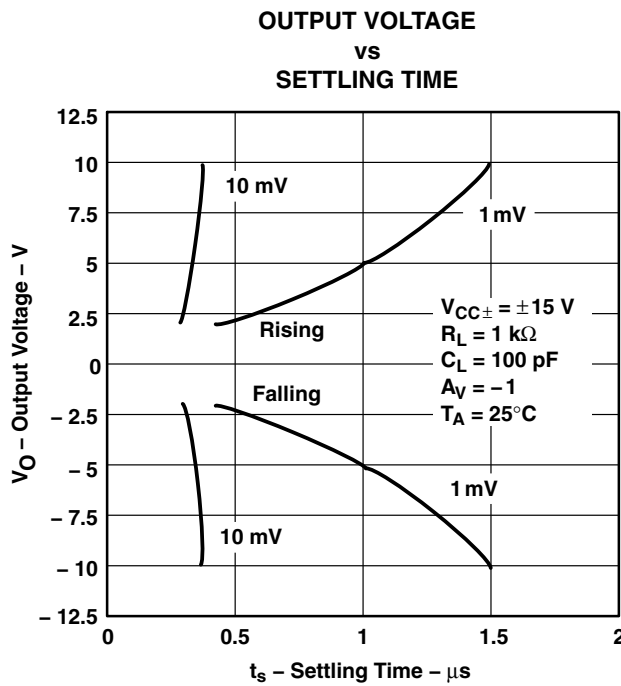


Figure 24

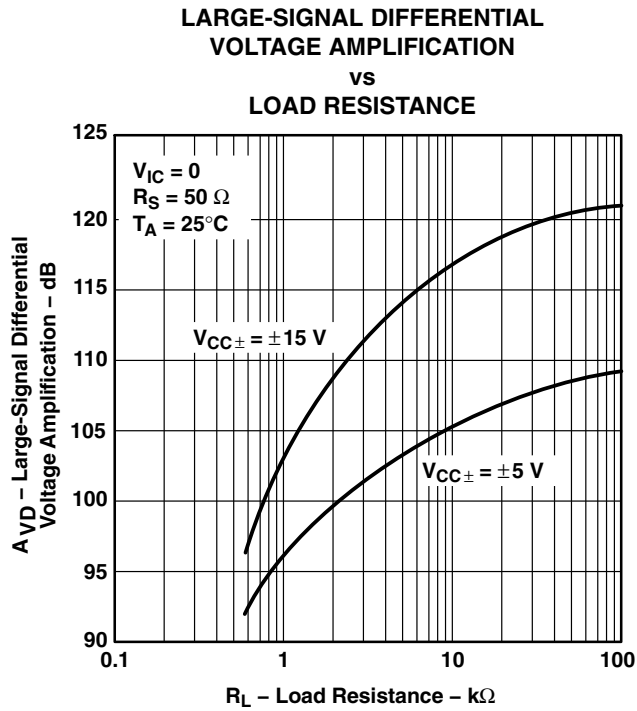


Figure 25

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

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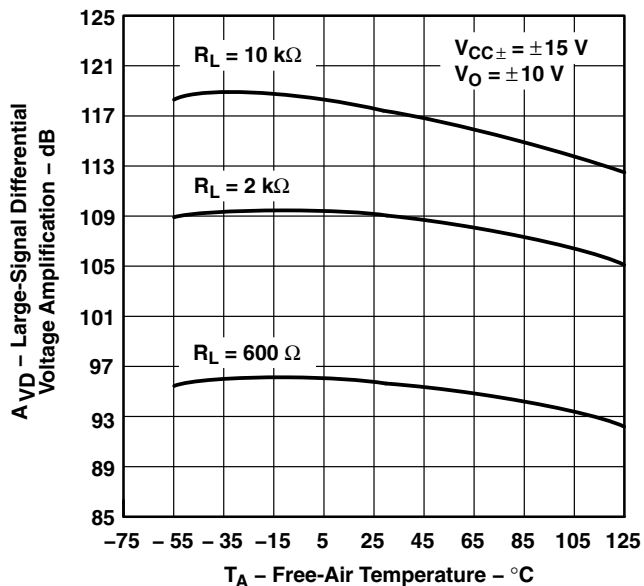
**TYPICAL CHARACTERISTICS**

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



**Figure 26**

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



**Figure 27**

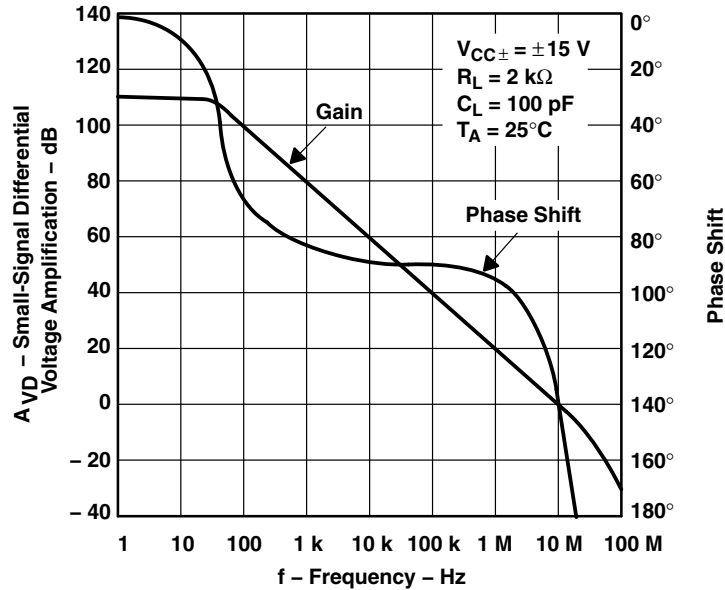
† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



**TYPICAL CHARACTERISTICS**

**SMALL-SIGNAL DIFFERENTIAL VOLTAGE  
 AMPLIFICATION AND PHASE SHIFT**

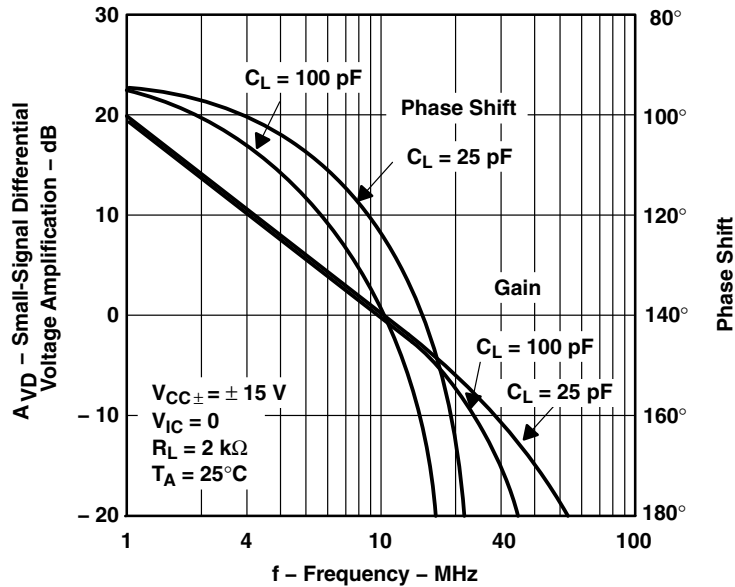
vs  
**FREQUENCY**



**Figure 28**

**SMALL-SIGNAL DIFFERENTIAL VOLTAGE  
 AMPLIFICATION AND PHASE SHIFT**

vs  
**FREQUENCY**



**Figure 29**

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## TYPICAL CHARACTERISTICS



Figure 30



Figure 31



Figure 32



Figure 33

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



TYPICAL CHARACTERISTICS

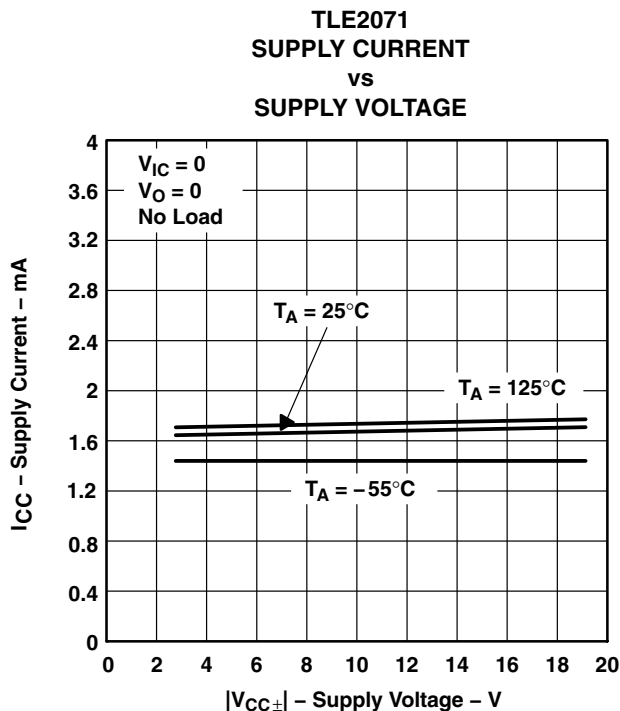


Figure 34

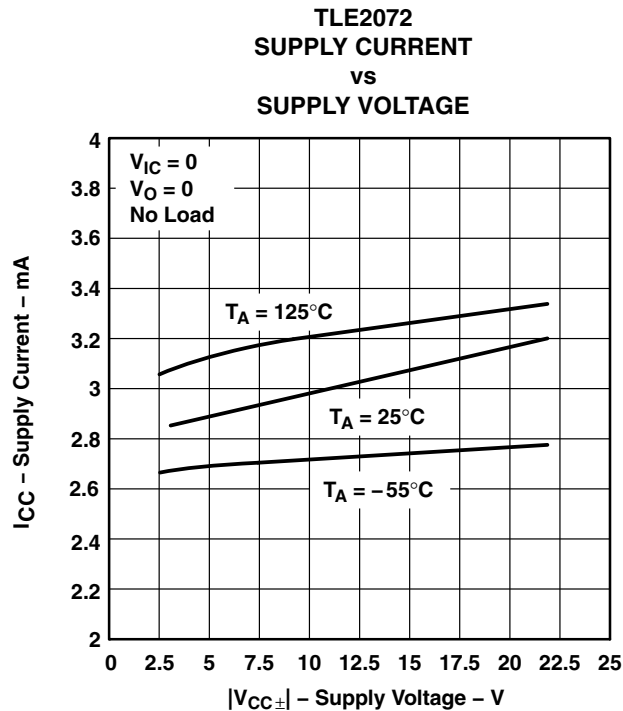


Figure 35

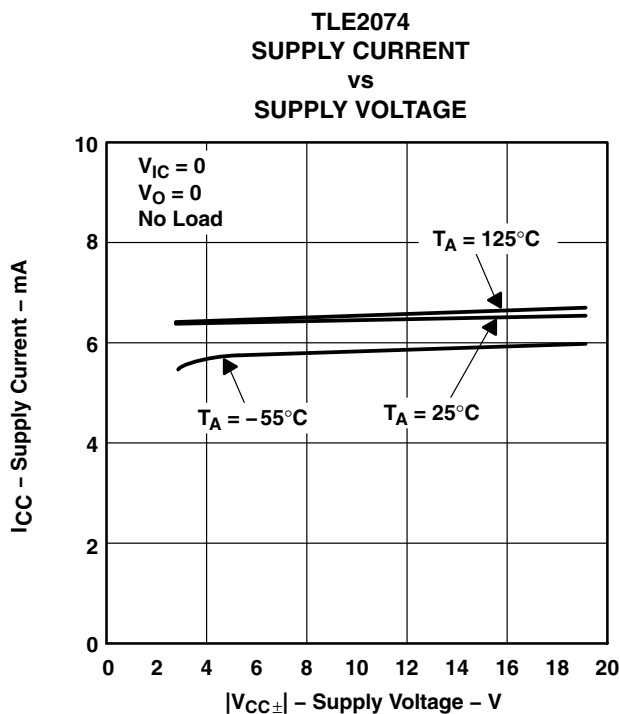


Figure 36

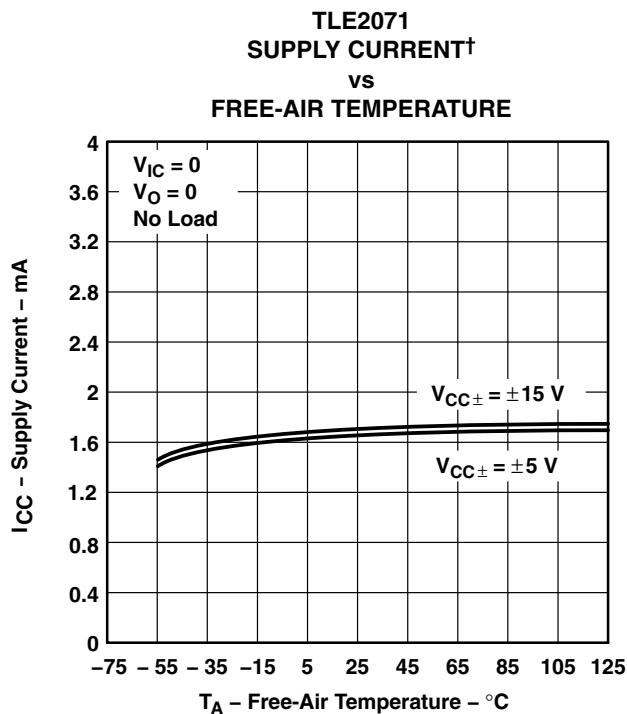


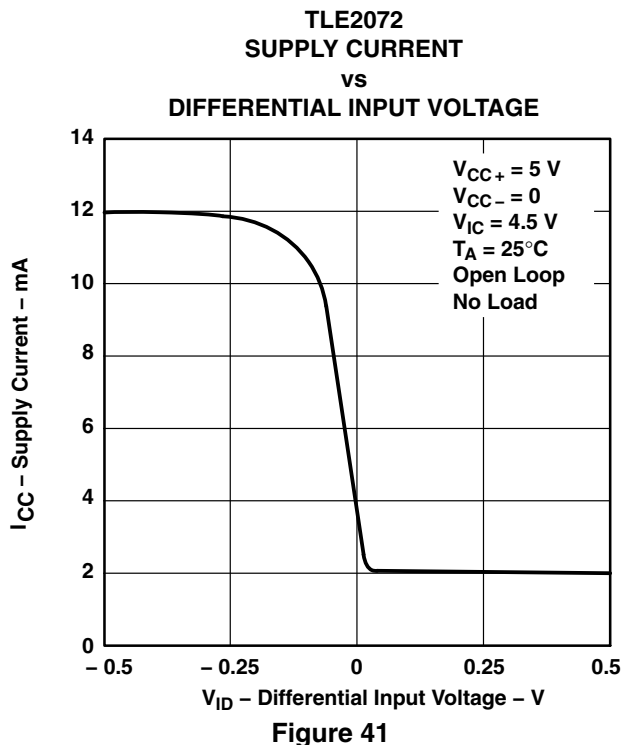
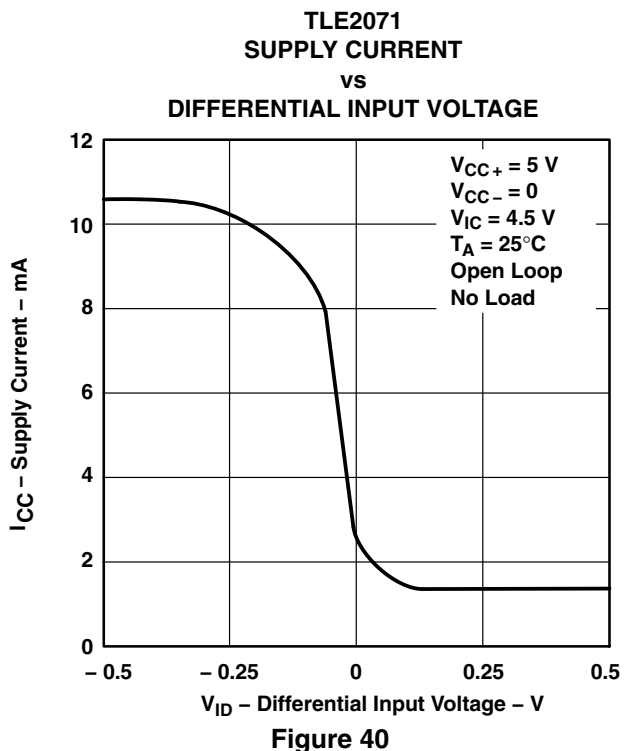
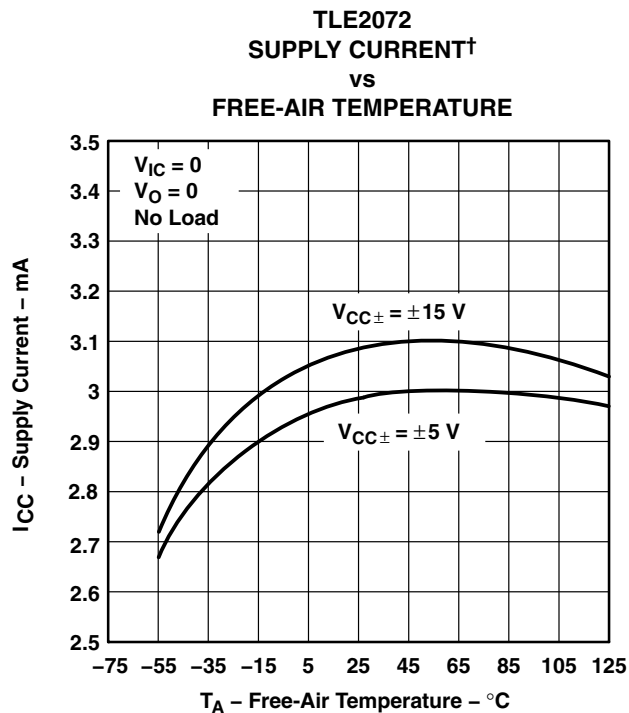
Figure 37

† 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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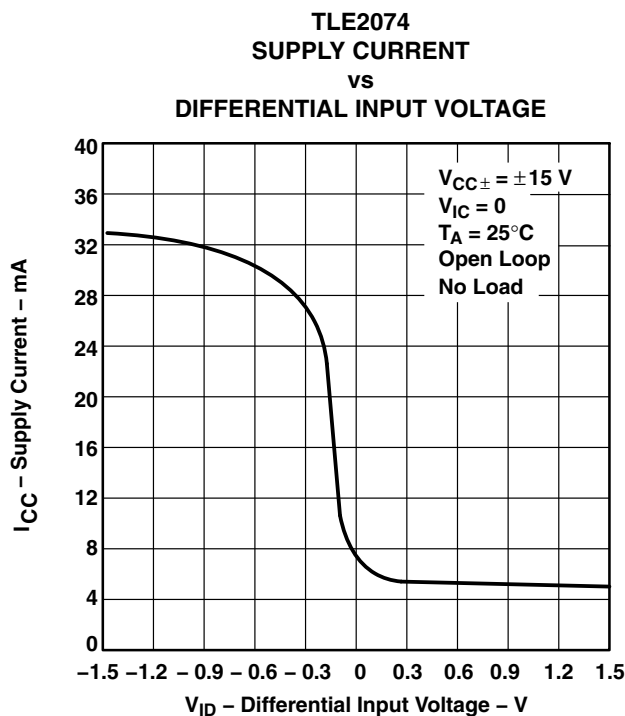
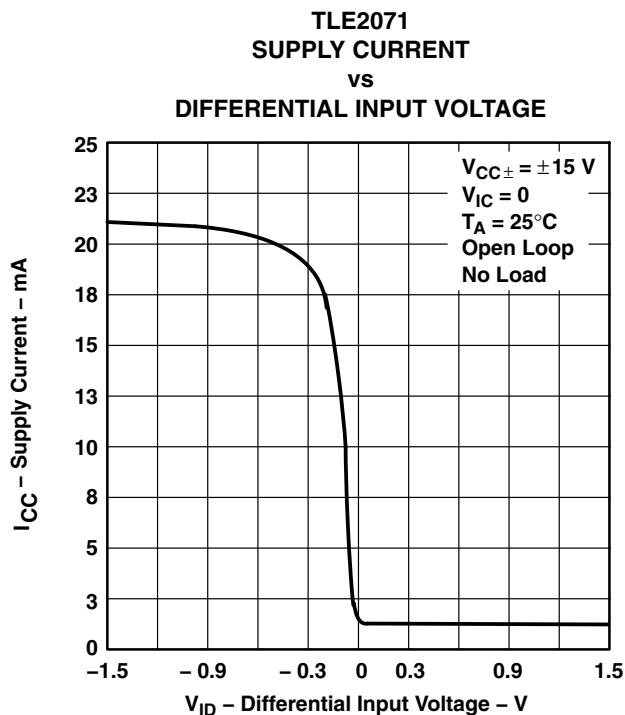
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## TYPICAL CHARACTERISTICS



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

TYPICAL CHARACTERISTICS



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## TYPICAL CHARACTERISTICS

SHORT-CIRCUIT OUTPUT CURRENT  
vs  
SUPPLY VOLTAGE



Figure 46

SHORT-CIRCUIT OUTPUT CURRENT  
vs  
ELAPSED TIME



Figure 47

SHORT-CIRCUIT OUTPUT CURRENT†  
vs  
FREE-AIR TEMPERATURE



Figure 48

SLEW RATE†  
vs  
FREE-AIR TEMPERATURE



Figure 49

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

**TYPICAL CHARACTERISTICS**



Figure 50

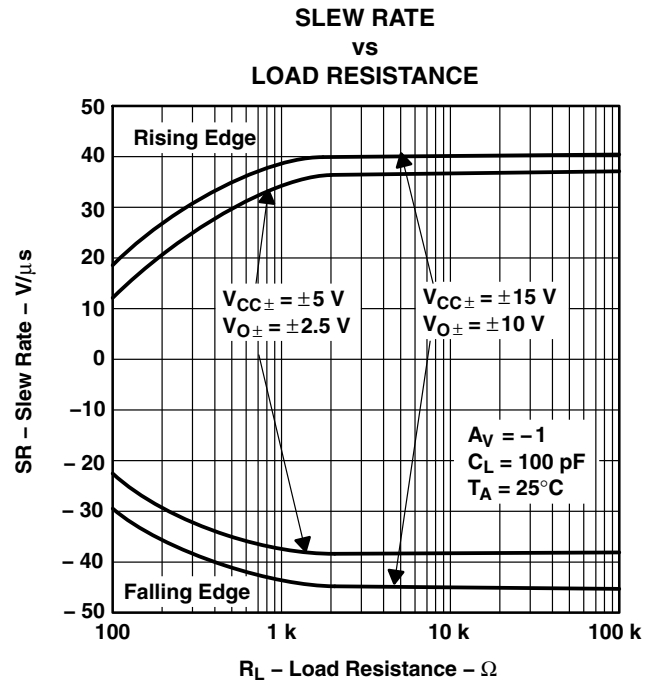


Figure 51



Figure 52

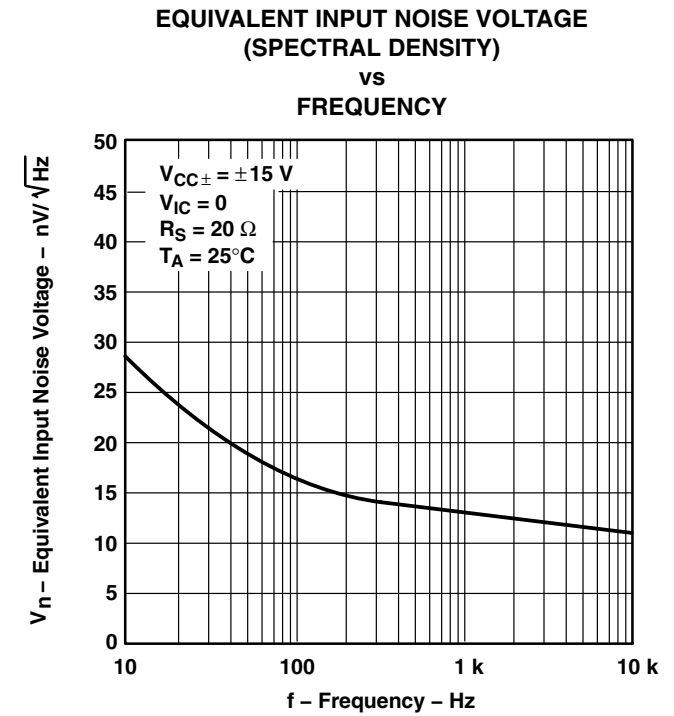


Figure 53

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

# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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## TYPICAL CHARACTERISTICS

INPUT-REFERRED NOISE VOLTAGE  
vs  
NOISE BANDWIDTH



Figure 54

INPUT-REFERRED NOISE VOLTAGE  
OVER A 10-SECOND TIME INTERVAL



Figure 55

THIRD-OCTAVE SPECTRAL NOISE DENSITY  
vs  
FREQUENCY BANDS



Figure 56

TOTAL HARMONIC DISTORTION PLUS NOISE  
vs  
FREQUENCY



Figure 57

**TYPICAL CHARACTERISTICS**

**TOTAL HARMONIC DISTORTION PLUS NOISE  
 vs  
 FREQUENCY**



**Figure 58**

**UNITY-GAIN BANDWIDTH  
 vs  
 LOAD CAPACITANCE**



**Figure 59**

**GAIN-BANDWIDTH PRODUCT†  
 vs  
 FREE-AIR TEMPERATURE**



**Figure 60**

**GAIN-BANDWIDTH PRODUCT  
 vs  
 SUPPLY VOLTAGE**



**Figure 61**

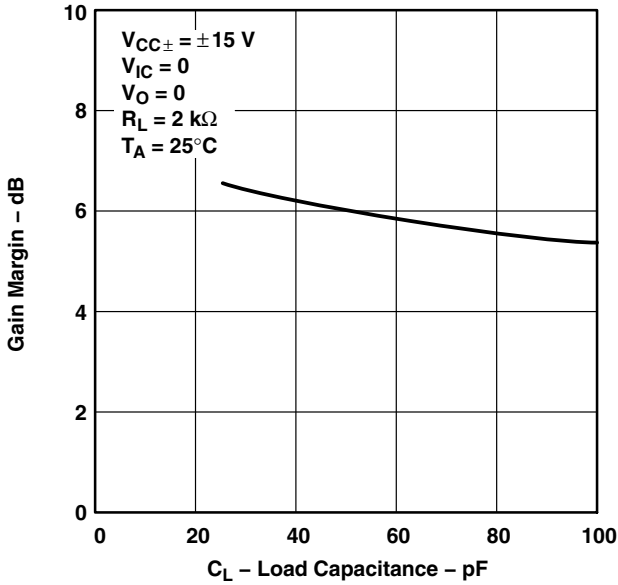
† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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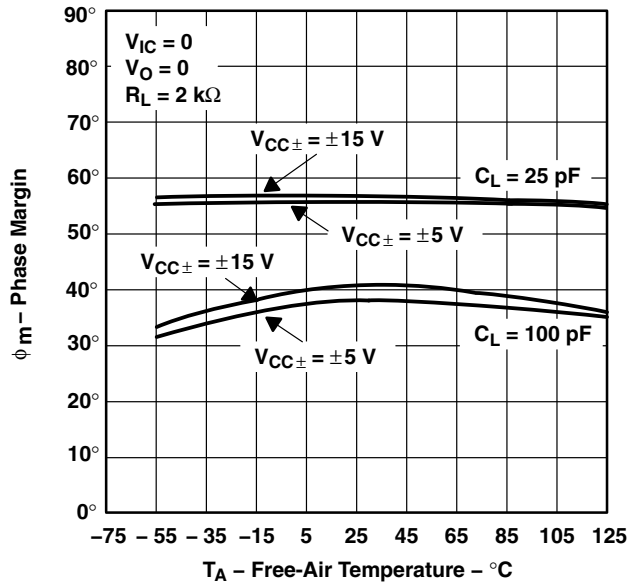
**TYPICAL CHARACTERISTICS**

**GAIN MARGIN**  
**vs**  
**LOAD CAPACITANCE**



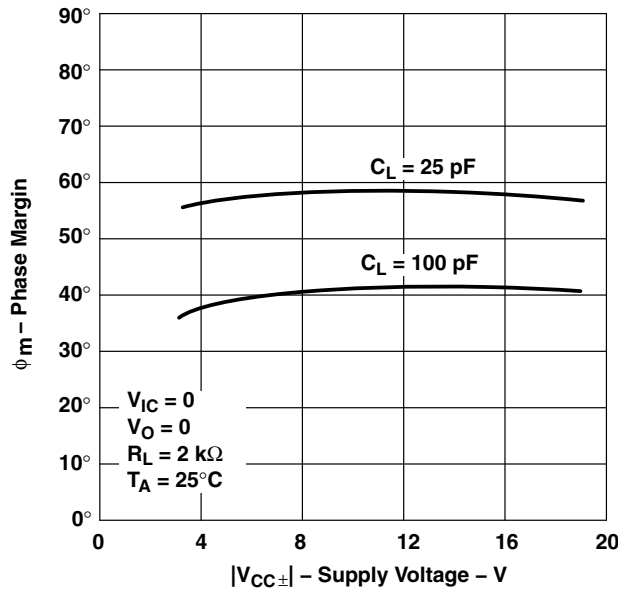
**Figure 62**

**PHASE MARGIN†**  
**vs**  
**FREE-AIR TEMPERATURE**



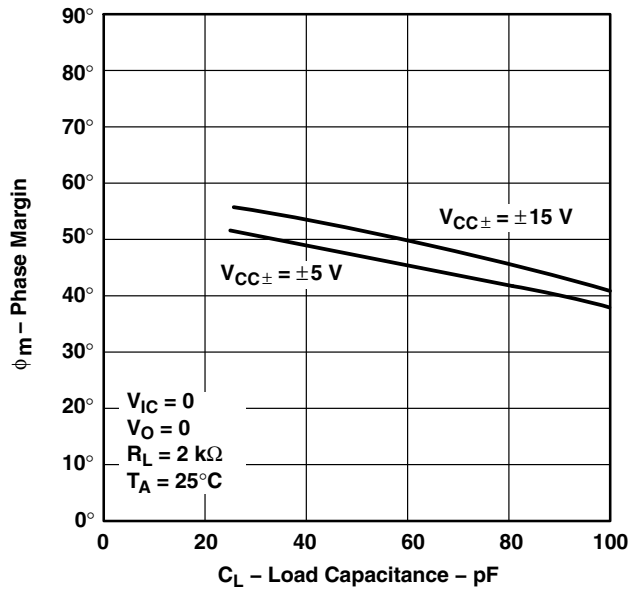
**Figure 63**

**PHASE MARGIN**  
**vs**  
**SUPPLY VOLTAGE**



**Figure 64**

**PHASE MARGIN**  
**vs**  
**LOAD CAPACITANCE**



**Figure 65**

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



TYPICAL CHARACTERISTICS

NONINVERTING LARGE-SIGNAL  
 PULSE RESPONSE†



Figure 66

SMALL-SIGNAL PULSE RESPONSE



Figure 67

CLOSED-LOOP OUTPUT IMPEDANCE  
 vs  
 FREQUENCY



Figure 68

TLE2072 AND TLE2074  
 CROSSTALK ATTENUATION  
 vs  
 FREQUENCY



Figure 69

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

# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS181C – FEBRUARY 1997 – REVISED DECEMBER 2009

## APPLICATION INFORMATION

### input characteristics

The TLE207x, TLE207xA, and TLE207xB are specified with a minimum and a maximum input voltage that if exceeded at either input could cause the device to malfunction. Because of the extremely high input impedance and resulting low bias current requirements, the TLE207x, TLE207xA, and TLE207xB are well suited for low-level signal processing; however, leakage currents on printed-circuit boards and sockets can easily exceed bias current requirements and cause degradation in system performance. It is good practice to include guard rings around inputs (see Figure 70). These guards should be driven from a low-impedance source at the same voltage level as the common-mode input.

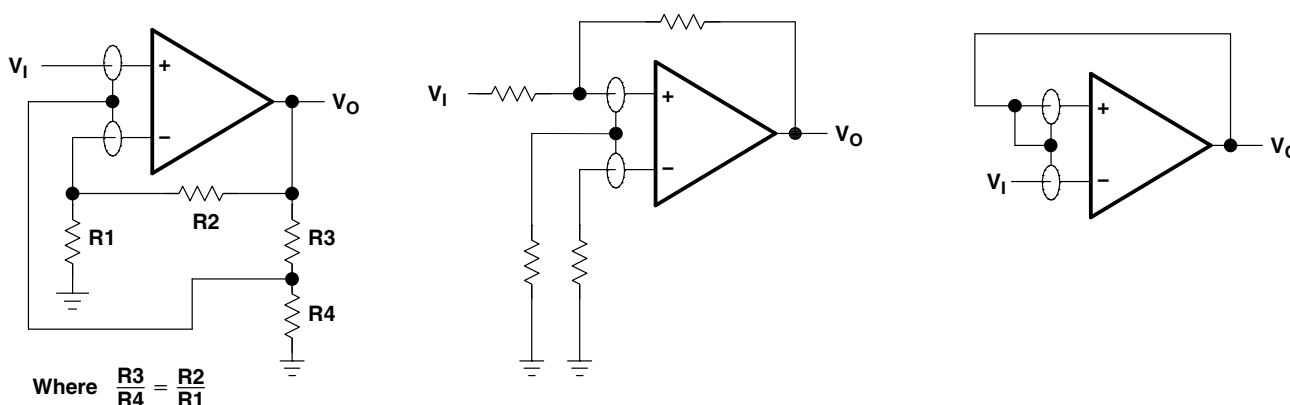


Figure 70. Use of Guard Rings

### TLE2071 input offset voltage nulling

The TLE2071 series offers external null pins that can be used to further reduce the input offset voltage. The circuit of Figure 71 can be connected as shown if the feature is desired. When external nulling is not needed, the null pins may be left unconnected.



Figure 71. Input Offset Voltage Nulling

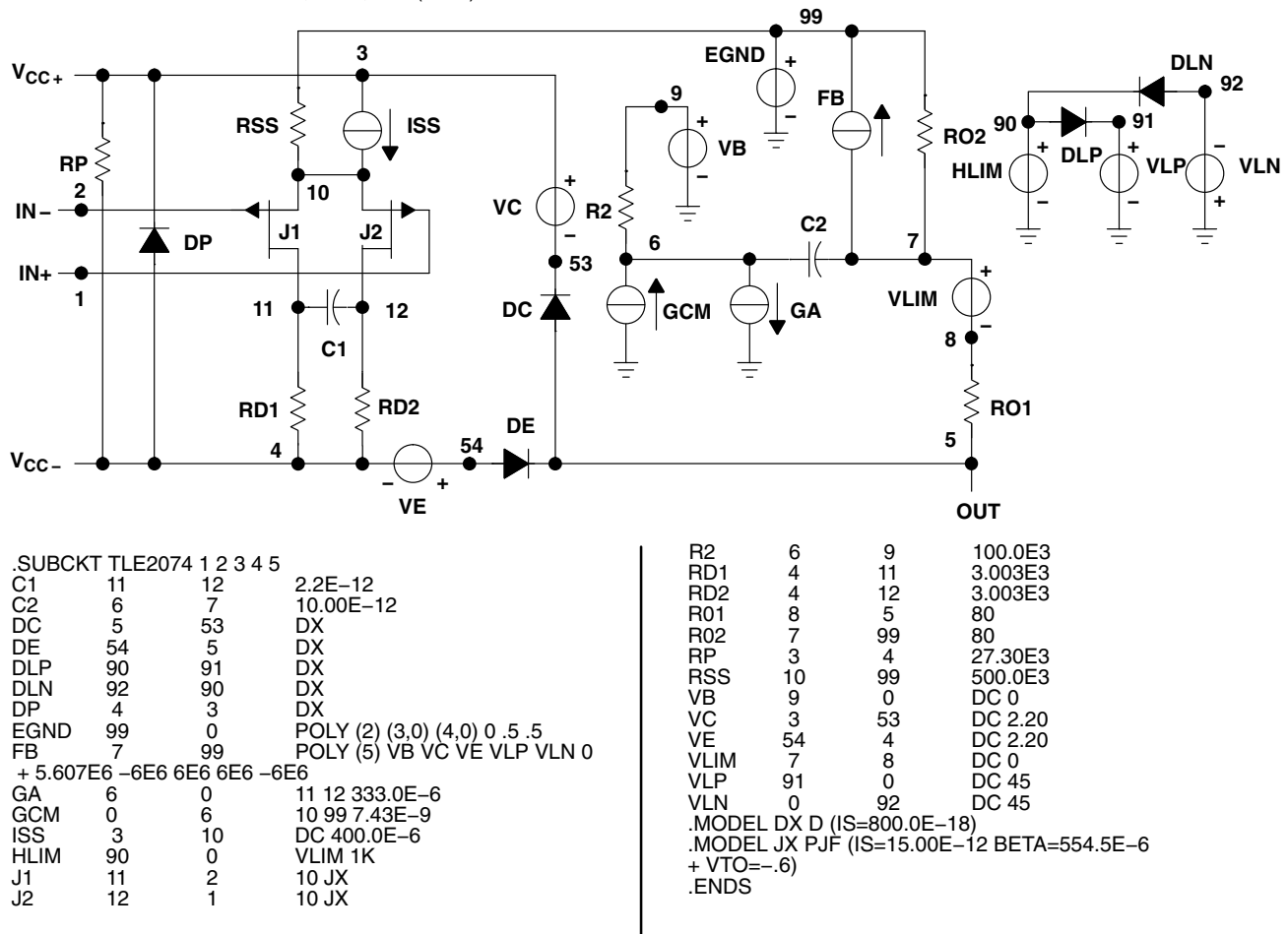
## APPLICATION INFORMATION

### macromodel information

Macromodel information provided was derived using *PSpice™ Parts™* model generation software. The Boyle macromodel (see Note 4) and subcircuit Figure 72 were generated using the TLE207x 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 4: 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 72. Boyle Macromodel and Subcircuit**

*PSpice* and *Parts* are trademarks of MicroSim Corporation.

# TLE207x, TLE207xA EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS181C – FEBRUARY 1997 – REVISED DECEMBER 2009

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## Revision History

Version	Date	Changes
C	Dec-2009	<ul style="list-style-type: none"><li>– For TLE2071M/1AM (VCC <math>\pm 5V</math>) changed <math>V_n</math> NOM &amp; MAX from 28/55 to 48/85 (f = 10 Hz); 11.6/17 to 12/17 (f = 10 KHz), Pg. 16</li><li>– For TLE2071M/1AM (VCC <math>\pm 15V</math>) changed <math>V_n</math> NOM &amp; MAX from 28/55 to 48/85 (f = 10 Hz); 11.6/17 to 12/17 (f = 10 KHz), Pg. 18</li><li>– For TLE2072M/2AM (VCC <math>\pm 5V</math>) changed <math>V_n</math> NOM &amp; MAX from 28/55 to 48/85 (f = 10 Hz); 11.6/17 to 12/17 (f = 10 KHz), Pg. 29</li><li>– For TLE2072M/2AM (VCC <math>\pm 15V</math>) changed <math>V_n</math> NOM &amp; MAX from 28/55 to 48/85 (f = 10 Hz); 11.6/17 to 12/17 (f = 10 KHz), Pg. 31</li><li>– For TLE2074M/4AM (VCC <math>\pm 5V</math>) changed <math>V_n</math> NOM &amp; MAX from 28/55 to 48/85 (f = 10 Hz); 11.6/17 to 12/17 (f = 10 KHz), Pg. 42</li><li>– For TLE2074M/4AM (VCC <math>\pm 15V</math>) changed <math>V_n</math> NOM &amp; MAX from 28/55 to 48/85 (f = 10 Hz); 11.6/17 to 12/17 (f = 10 KHz), Pg. 44</li></ul>



**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)
<a href="#">5962-9460201Q2A</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460201Q2A TLE2071 MFKB
<a href="#">5962-9460201QPA</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460201QPA TLE2071M
<a href="#">5962-9460202Q2A</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460202Q2A TLE2072 MFKB
<a href="#">5962-9460202QHA</a>	Active	Production	CFP (U)   10	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460202QHA TLE2072M
<a href="#">5962-9460202QPA</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460202QPA TLE2072M
<a href="#">5962-9460203Q2A</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460203Q2A TLE2074 MFKB
<a href="#">5962-9460203QCA</a>	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460203QC A TLE2074MJB
<a href="#">5962-9460204Q2A</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962 9460204Q2A TLE2071 AMFKB
<a href="#">5962-9460204QHA</a>	Active	Production	CFP (U)   10	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460204QHA TLE2071AM
<a href="#">5962-9460204QPA</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460204QPA TLE2071AM
<a href="#">5962-9460205Q2A</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460205Q2A TLE2072 AMFKB
<a href="#">5962-9460205QHA</a>	Active	Production	CFP (U)   10	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460205QHA TLE2072AM

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)
<a href="#">5962-9460205QPA</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460205QPA TLE2072AM
<a href="#">5962-9460206Q2A</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460206Q2A TLE2074 AMFKB
<a href="#">5962-9460206QCA</a>	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460206QC A TLE2074AMJB
<a href="#">5962-9460206QDA</a>	Active	Production	CFP (W)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460206QD A TLE2074AMWB
<a href="#">TLE2071ACD</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	0 to 70	2071AC
<a href="#">TLE2071ACDR</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	2071AC
<a href="#">TLE2071ACP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2071AC
<a href="#">TLE2071AID</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-40 to 85	2071AI
<a href="#">TLE2071AIDR</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	2071AI
<a href="#">TLE2071AIP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2071AI
<a href="#">TLE2071AMFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962 9460204Q2A TLE2071 AMFKB
<a href="#">TLE2071AMJG</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLE2071 AMJG
<a href="#">TLE2071AMJGB</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460204QPA TLE2071AM
<a href="#">TLE2071AMUB</a>	Active	Production	CFP (U)   10	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460204QHA TLE2071AM
<a href="#">TLE2071CD</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	0 to 70	2071C
<a href="#">TLE2071CP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2071CP
<a href="#">TLE2071ID</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-40 to 85	2071I
<a href="#">TLE2071IDR</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	2071I
<a href="#">TLE2071IP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2071IP

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)
<a href="#">TLE2071MFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460201Q2A TLE2071 MFKB
<a href="#">TLE2071MJG</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLE2071MJG
<a href="#">TLE2071MJGB</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460201QPA TLE2071M
<a href="#">TLE2072ACD</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	0 to 70	2072AC
<a href="#">TLE2072ACP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2072AC
<a href="#">TLE2072AID</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-40 to 85	2072AI
<a href="#">TLE2072AIDR</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	2072AI
<a href="#">TLE2072AIP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2072AI
<a href="#">TLE2072AMFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460205Q2A TLE2072 AMFKB
<a href="#">TLE2072AMJG</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLE2072 AMJG
<a href="#">TLE2072AMJGB</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460205QPA TLE2072AM
<a href="#">TLE2072AMUB</a>	Active	Production	CFP (U)   10	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460205QHA TLE2072AM
<a href="#">TLE2072CD</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-	2072C
<a href="#">TLE2072CDR</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	2072C
<a href="#">TLE2072CP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2072CP
<a href="#">TLE2072ID</a>	Obsolete	Production	SOIC (D)   8	-	-	Call TI	Call TI	-	2072I
<a href="#">TLE2072IDR</a>	Active	Production	SOIC (D)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	2072I
<a href="#">TLE2072IP</a>	Active	Production	PDIP (P)   8	50   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2072IP
<a href="#">TLE2072MFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460202Q2A TLE2072 MFKB
<a href="#">TLE2072MJG</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLE2072MJG

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)
<a href="#">TLE2072MJGB</a>	Active	Production	CDIP (JG)   8	50   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460202QPA TLE2072M
<a href="#">TLE2072MUB</a>	Active	Production	CFP (U)   10	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	9460202QHA TLE2072M
<a href="#">TLE2074ACDW</a>	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLE2074AC
<a href="#">TLE2074ACN</a>	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2074ACN
<a href="#">TLE2074AIDW</a>	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TLE2074AI
<a href="#">TLE2074AIN</a>	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2074AIN
<a href="#">TLE2074AMFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460206Q2A TLE2074 AMFKB
<a href="#">TLE2074AMJ</a>	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLE2074AMJ
<a href="#">TLE2074AMJB</a>	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460206QC A TLE2074AMJB
<a href="#">TLE2074AMWB</a>	Active	Production	CFP (W)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460206QD A TLE2074AMWB
<a href="#">TLE2074CDW</a>	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	TLE2074C
<a href="#">TLE2074CDWR</a>	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	TLE2074C
<a href="#">TLE2074CN</a>	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2074CN
<a href="#">TLE2074IDW</a>	Active	Production	SOIC (DW)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	TLE2074I
<a href="#">TLE2074IDWR</a>	Active	Production	SOIC (DW)   16	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-	TLE2074I
<a href="#">TLE2074IN</a>	Active	Production	PDIP (N)   14	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	-	TLE2074IN
<a href="#">TLE2074MFKB</a>	Active	Production	LCCC (FK)   20	55   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962- 9460203Q2A TLE2074 MFKB
<a href="#">TLE2074MJ</a>	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TLE2074MJ
<a href="#">TLE2074MJB</a>	Active	Production	CDIP (J)   14	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-9460203QC A TLE2074MJB

(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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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 TLE2071, TLE2071A, TLE2071AM, TLE2071M, TLE2072, TLE2072A, TLE2072AM, TLE2072M, TLE2074, TLE2074A, TLE2074AM, TLE2074M :**

- Catalog : [TLE2071A](#), [TLE2071](#), [TLE2072A](#), [TLE2072](#), [TLE2074A](#), [TLE2074](#)
- Automotive : [TLE2071A-Q1](#), [TLE2071A-Q1](#), [TLE2072A-Q1](#), [TLE2072A-Q1](#)
- Military : [TLE2071M](#), [TLE2071AM](#), [TLE2072M](#), [TLE2072AM](#), [TLE2074M](#), [TLE2074AM](#)

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**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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
TLE2071ACDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2071AIDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2071IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2072AIDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2072AIDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2072CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2072IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2072IDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TLE2074CDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
TLE2074IDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	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)
TLE2071ACDR	SOIC	D	8	2500	353.0	353.0	32.0
TLE2071AIDR	SOIC	D	8	2500	353.0	353.0	32.0
TLE2071IDR	SOIC	D	8	2500	353.0	353.0	32.0
TLE2072AIDR	SOIC	D	8	2500	353.0	353.0	32.0
TLE2072AIDR	SOIC	D	8	2500	367.0	367.0	35.0
TLE2072CDR	SOIC	D	8	2500	353.0	353.0	32.0
TLE2072IDR	SOIC	D	8	2500	353.0	353.0	32.0
TLE2072IDR	SOIC	D	8	2500	356.0	356.0	35.0
TLE2074CDWR	SOIC	DW	16	2000	350.0	350.0	43.0
TLE2074IDWR	SOIC	DW	16	2000	350.0	350.0	43.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-9460201Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9460202Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9460202QHA	U	CFP	10	25	506.98	26.16	6220	NA
5962-9460203Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9460204Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9460204QHA	U	CFP	10	25	506.98	26.16	6220	NA
5962-9460205Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9460205QHA	U	CFP	10	25	506.98	26.16	6220	NA
5962-9460206Q2A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-9460206QDA	W	CFP	14	25	506.98	26.16	6220	NA
TLE2071ACP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2071AIP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2071AMFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLE2071AMUB	U	CFP	10	25	506.98	26.16	6220	NA
TLE2071CP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2071IP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2071MFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLE2072ACP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2072AIP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2072AMFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLE2072AMUB	U	CFP	10	25	506.98	26.16	6220	NA
TLE2072CP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2072IP	P	PDIP	8	50	506	13.97	11230	4.32
TLE2072MFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLE2072MUB	U	CFP	10	25	506.98	26.16	6220	NA
TLE2074ACDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
TLE2074ACN	N	PDIP	14	25	506	13.97	11230	4.32
TLE2074AIDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
TLE2074AIN	N	PDIP	14	25	506	13.97	11230	4.32

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Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
TLE2074AMFKB	FK	LCCC	20	55	506.98	12.06	2030	NA
TLE2074AMWB	W	CFP	14	25	506.98	26.16	6220	NA
TLE2074CDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
TLE2074CN	N	PDIP	14	25	506	13.97	11230	4.32
TLE2074IDW	DW	SOIC	16	40	506.98	12.7	4826	6.6
TLE2074IN	N	PDIP	14	25	506	13.97	11230	4.32
TLE2074MFKB	FK	LCCC	20	55	506.98	12.06	2030	NA

# PACKAGE OUTLINE

## JG0008A

### 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



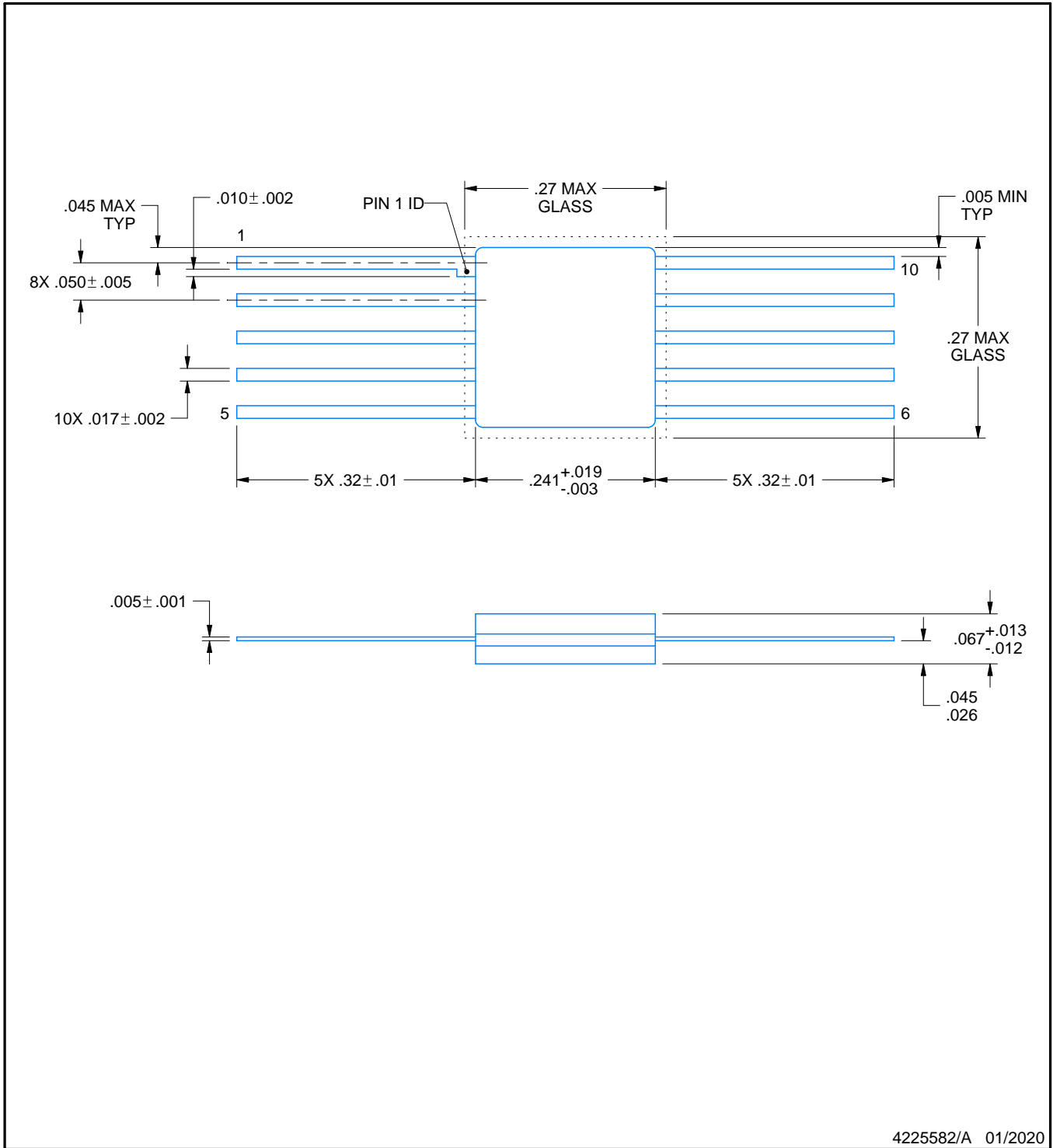
U0010A



PACKAGE OUTLINE

CFP - 2.03 mm max height

CERAMIC FLATPACK



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.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F14

## GENERIC PACKAGE VIEW

**DW 16**

**SOIC - 2.65 mm max height**

7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

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



4224780/A

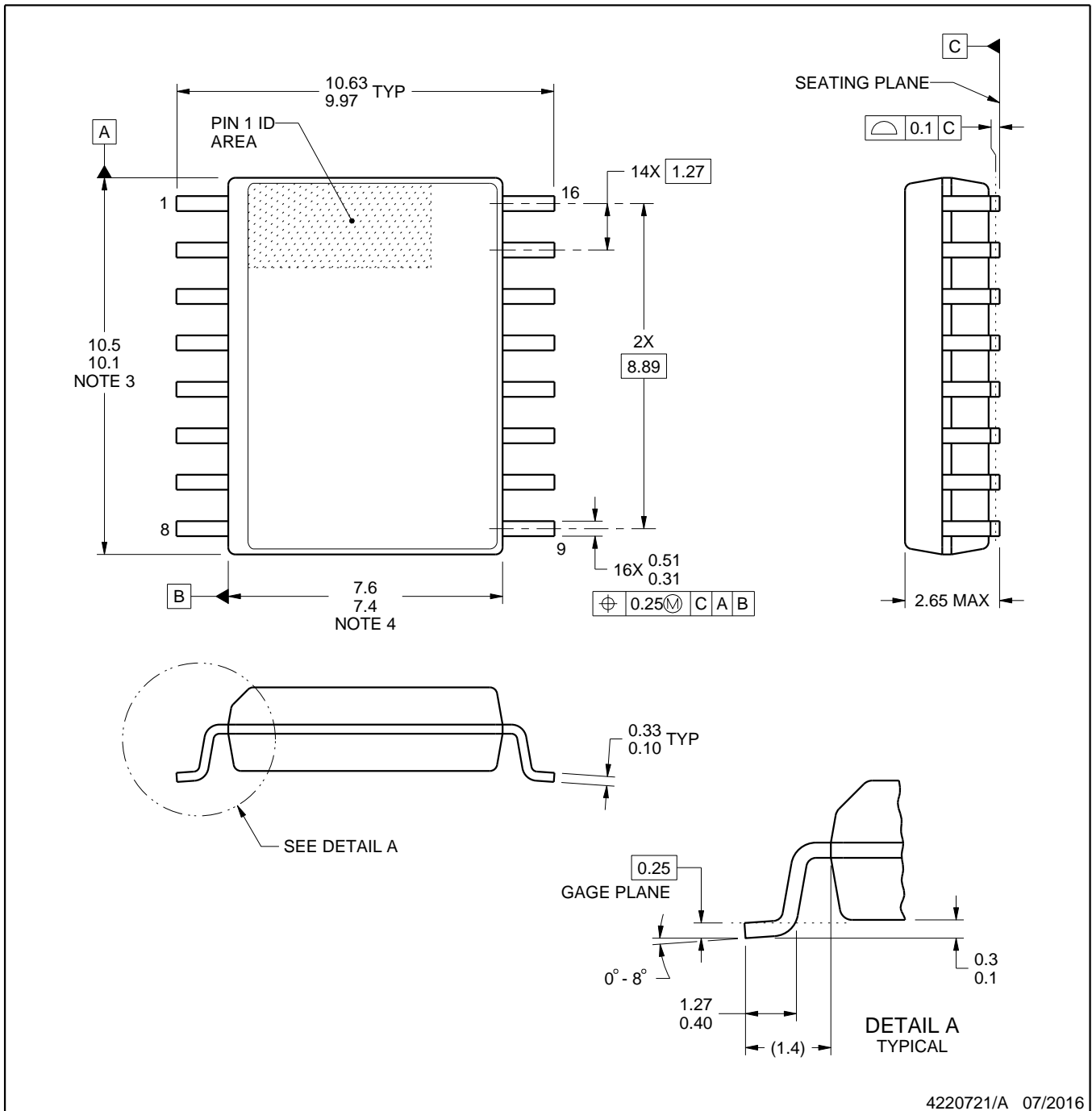


DW0016A

# PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

## NOTES:

1. All linear dimensions are in millimeters. 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 MS-013.

# EXAMPLE BOARD LAYOUT

DW0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:7X



SOLDER MASK DETAILS

4220721/A 07/2016

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

DW0016A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220721/A 07/2016

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



4214771/A 05/2017

### 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.

# EXAMPLE BOARD LAYOUT

J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE  
NON-SOLDER MASK DEFINED  
SCALE: 5X



4214771/A 05/2017



# D0008A

# PACKAGE OUTLINE

## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4214825/C 02/2019

### NOTES:

- 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.
- This drawing is subject to change without notice.
- 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.
- This dimension does not include interlead flash.
- Reference JEDEC registration MS-012, variation AA.

# EXAMPLE BOARD LAYOUT

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\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

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