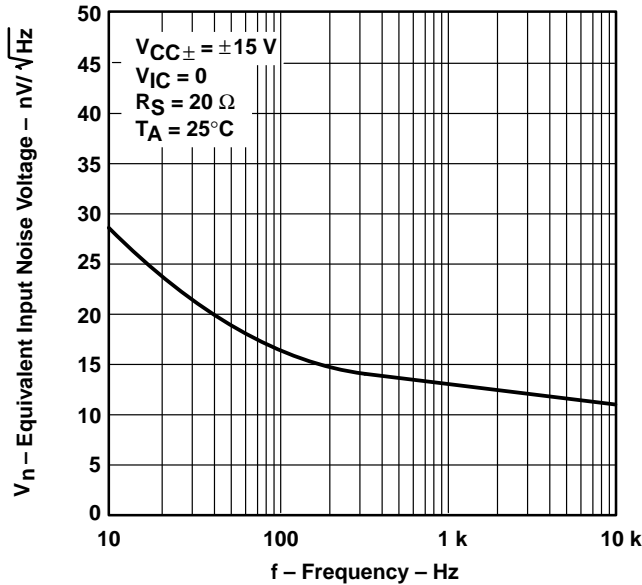


# TLE2071, TLE2071A, TLE2071Y EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

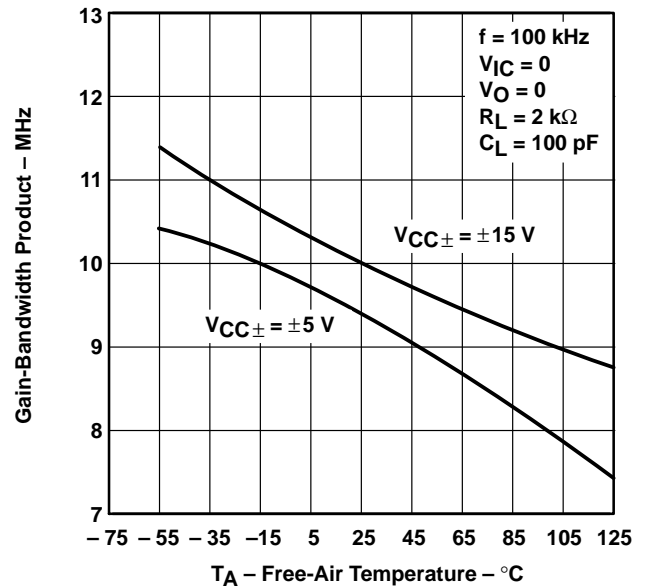
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- 40-V/ $\mu$ s Slew Rate Typ
- Low Noise  
17 nV/ $\sqrt{\text{Hz}}$  Max at  $f = 10 \text{ kHz}$   
11.6 nV/ $\sqrt{\text{Hz}}$  Typ at  $f = 10 \text{ kHz}$
- High Gain-Bandwidth Product . . . 10 MHz
- $\pm 30\text{-mA}$  Minimum Short-Circuit Output Current
- Wide Supply Range . . .  $\pm 2.25 \text{ V}$  to  $\pm 19 \text{ V}$
- Input Range Includes the Positive Supply
- Macromodel Included
- Fast Settling Time Using 10-V Step  
400 ns to 10 mV Typ  
1.5  $\mu$ s to 1 mV Typ

EQUIVALENT INPUT NOISE VOLTAGE  
VS  
FREQUENCY



GAIN-BANDWIDTH PRODUCT  
VS  
FREE-AIR TEMPERATURE



## description

The TLE2071 and TLE2071A are low-noise, high-performance, high-speed, internally compensated JFET-input operational amplifiers built using Texas Instruments complementary bipolar Excalibur process. The TLE2071 and TLE2071A have maximum noise specifications for designs requiring certain noise limitations. Both are pin-compatible upgrades to standard industry products.

## AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGED DEVICES				CHIP FORM (Y)
		SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	
0°C to 70°C	2 mV	TLE2071ACD	—	—	TLE2071ACP	—
	4 mV	TLE2071CD	—	—	TLE2071CP	TLE2071Y
-40°C to 85°C	2 mV	TLE2071AID	—	—	TLE2071AIP	—
	4 mV	TLE2071ID	—	—	TLE2071IP	—
-55°C to 125°C	2 mV	—	TLE2071AMFK	TLE2071AMJG	—	—
	4 mV	—	TLE2071MFK	TLE2071MJG	—	—

The D packages are available taped and reeled. Add R suffix to device type (e.g., TLE2071ACDR). Chip-form versions are tested at T<sub>A</sub> = 25°C. For chip-form orders, contact your local TI sales office.

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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On products compliant to MIL-STD-883, Class B, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# TLE2071, TLE2071A, TLE2071Y

## EXCALIBUR LOW-NOISE HIGH-SPEED

### JFET-INPUT OPERATIONAL AMPLIFIERS

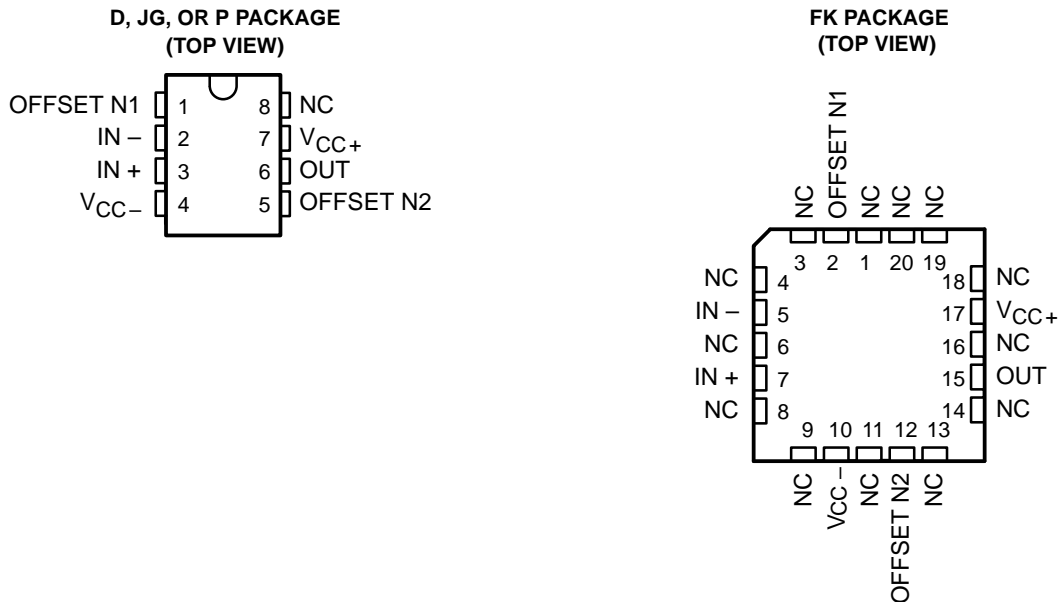
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#### description (continued)

The design features a 30-V/ $\mu$ s minimum slew rate, which results in a high-power bandwidth. A low audio-band noise of 28 nV/ $\sqrt{\text{Hz}}$  is typical with a 55 nV/ $\sqrt{\text{Hz}}$  maximum at 10 Hz. Settling time to 0.1% of a 10-V step (1-k $\Omega$ /100-pF load) is approximately 400 ns. Gain-bandwidth product is typically 10 MHz with an 8 MHz minimum. As such, the TLE2071 and TLE2071A offer significant speed and noise advantages at a low 1.7-mA typical supply current.

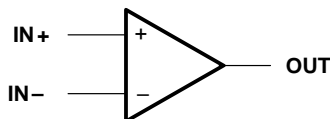
The input current characteristics traditionally associated with JFET-input amplifiers have been maintained. Input offset voltage is graded to a 4 mV and 2 mV maximum for the TLE2071 and TLE2071A, respectively. Typically, temperature coefficient of input offset voltage is 3.2  $\mu$ V/ $^{\circ}$ C and typical CMRR and  $k_{SVR}$  are 98 dB and 99 dB, respectively. Device performance is relatively independent of supply voltage over the wide  $\pm 2.25$ -V to  $\pm 19$ -V range. The input common-mode voltage range extends from the positive supply down to  $V_{CC-} + 4$  V without significant degradation to dynamic performance. Maximum peak output voltage swing is from  $V_{CC+} - 1$  V to  $V_{CC-} + 1$  V under light loading conditions. The output is capable of sourcing and sinking currents to at least 30 mA and can sustain shorts to either supply. Care must be taken to ensure that maximum power dissipation is not exceeded.

Both the TLE2071 and TLE2071A are available in a wide variety of packages, including both the industry-standard 8-pin small-outline version and chip form for high-density system applications. The C-suffix devices are characterized for operation from 0 $^{\circ}$ C to 70 $^{\circ}$ C, the I-suffix devices over the -40 $^{\circ}$ C to 85 $^{\circ}$ C range, and the M-suffix devices over the full military temperature range of -55 $^{\circ}$ C to 125 $^{\circ}$ C.



NC – No internal connection

#### symbol

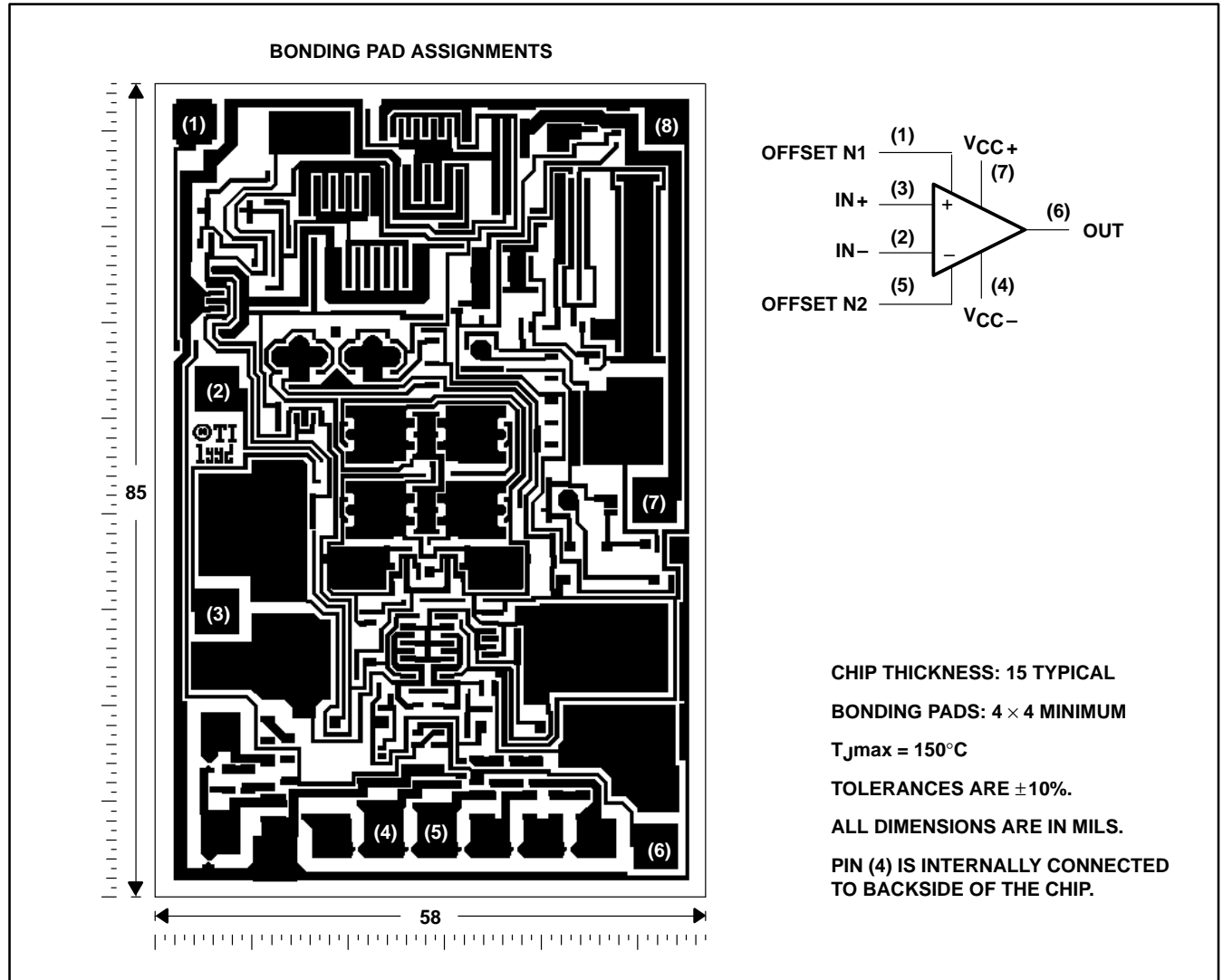


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 JFET-INPUT OPERATIONAL AMPLIFIERS

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**TLE2071Y chip information**

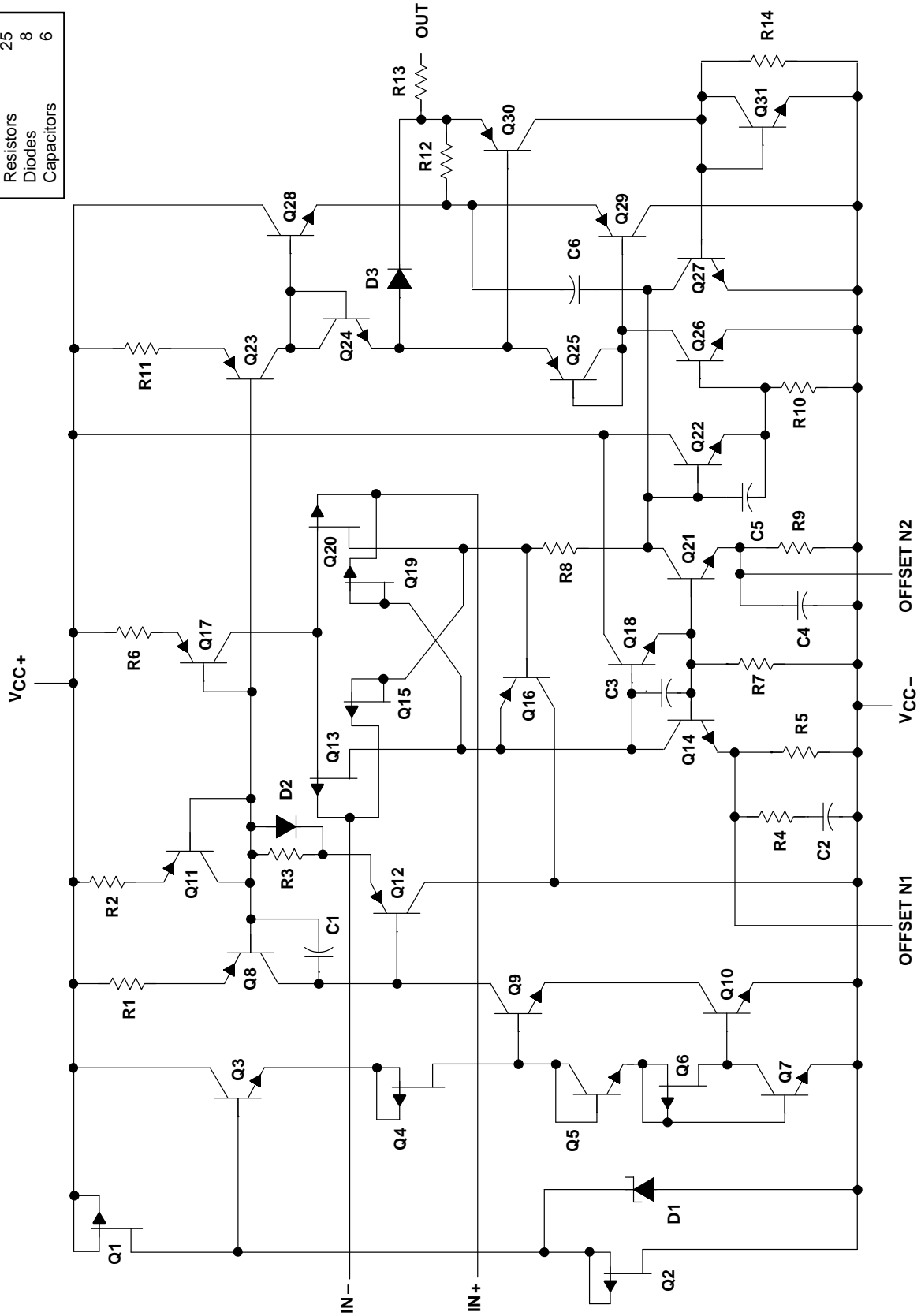
This chip, when properly assembled, displays characteristics similar to the TLE2071. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



**TLE2071, TLE2071A, TLE2071Y**  
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ACTUAL DEVICE COMPONENT COUNT	
Transistors	33
Resistors	25
Diodes	8
Capacitors	6

equivalent schematic



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

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)	±1 mA
Output current, $I_O$ (each output)	±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
Continuous total dissipation	See Dissipation Rating Table
Operating free-air temperature range, $T_A$ : C suffix	0°C to 70°C
I suffix	–40°C to 85°C
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: D or P package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package	300°C

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

- NOTES: 1. All voltage values except differential voltages are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .  
 2. Differential voltages are at  $IN+$  with respect to  $IN-$ .  
 3. The output can be shorted to either supply. Temperatures and/or supply voltages must be limited to ensure that the maximum dissipation rate is not exceeded.

**DISSIPATION RATING TABLE**

PACKAGE	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$	$T_A = 85^\circ\text{C}$	$T_A = 125^\circ\text{C}$
	POWER RATING		POWER RATING	POWER RATING	POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
P	1000 mW	8.0 mW/°C	640 mW	344 mW	200 mW

**recommended operating conditions**

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

**TLE2071, TLE2071A, TLE2071Y**  
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**electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  V (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50 \Omega$	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	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	5	100		5	100	pA		
		Full range		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	$I_O = -200 \mu A$	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	-3.5	-4.2		-3.5	-4.2	V		
		Full range	-3.4		-3.4					
	$I_O = 2$ mA	25°C	-3.7	-4.1		-3.7	-4.1			
		Full range	-3.6		-3.6					
	$I_O = 20$ 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 0°C to 70°C.



**TLE2071, TLE2071A, TLE2071Y**  
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**electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  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			2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	$V_{ID} = 1$ V	-35			-35			mA
		$V_{ID} = -1$ V	45			45			

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071C			TLE2071AC			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+ Positive slew rate	$V_{O(PP)} = \pm 2.3$ V, $A_{VD} = -1$ , $C_L = 100$ pF, $R_L = 2$ 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, $R_L = 1$ 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	$R_S = 20$ $\Omega$ , See Figure 3	f = 10 Hz	28	55		28	55	nV/ $\sqrt{Hz}$		
		f = 10 kHz	11.6	17		11.6	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/ $\sqrt{Hz}$	
THD + N Total harmonic distortion plus noise	$V_{O(PP)} = 5$ V, f = 1 kHz, $R_S = 25$ $\Omega$	$A_{VD} = 10$ , $R_L = 2$ k $\Omega$ ,	25°C	0.013%			0.013%			
$B_1$ Unity-gain bandwidth	$V_I = 10$ mV, $C_L = 25$ pF,	$R_L = 2$ k $\Omega$ , See Figure 2	25°C	9.4			9.4			MHz
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 4$ V, $R_L = 2$ k $\Omega$ ,	$A_{VD} = -1$ , $C_L = 25$ pF	25°C	2.8			2.8			MHz
$\phi_m$ Phase margin at unity gain	$V_I = 10$ mV, $C_L = 25$ pF,	$R_L = 2$ k $\Omega$ , See Figure 2	25°C	56°			56°			

† Full range is 0°C to 70°C.

**TLE2071, TLE2071A, TLE2071Y**  
**EXCALIBUR LOW-NOISE HIGH-SPEED**  
**JFET-INPUT OPERATIONAL AMPLIFIERS**

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**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	$V_{IC} = 0, V_O = 0,$ $R_S = 50 \Omega$	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	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0,$ See Figure 4	25°C	6	100		6	100	pA		
		Full range		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	$I_O = -200 \mu\text{A}$	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			81				

† Full range is 0°C to 70°C.





**TLE2071, TLE2071A, TLE2071Y**  
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**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		

**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 $\Omega$ , $C_L = 100$ pF, See Figure 1	25°C	30	40		30	40	V/ $\mu$ s	
			Full range	27			27			
SR–	Negative slew rate	See Figure 1	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	28	55		28	55	nV/ $\sqrt{Hz}$	
			f = 10 kHz	11.6	17		11.6	17		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	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.



**TLE2071, TLE2071A, TLE2071Y**  
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**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	$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ 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  $85^\circ\text{C}$ .



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**electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  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	1.6	2.2	1.35	1.6	2.2	mA
		Full range	2.2			2.2			
$I_{OS}$ Short-circuit output current	$V_O = 0$	25°C	-35			-35			mA
			45			45			

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071I			TLE2071AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
SR+ Positive slew rate	$V_{O(PP)} = \pm 2.3$ V, $A_{VD} = -1$ , $R_L = 2$ k $\Omega$ , $C_L = 100$ pF, See Figure 1	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	$A_{VD} = -1$ , 2-V step, $R_L = 1$ k $\Omega$ , $C_L = 100$ pF	25°C	0.25			0.25			$\mu$ s	
			0.4			0.4				
$V_n$ Equivalent input noise voltage	$R_S = 20$ $\Omega$ , See Figure 3	25°C	f = 10 Hz	28	55	28	55	nV/ $\sqrt{Hz}$		
			f = 10 kHz	11.6	17	11.6	17			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		f = 10 Hz to 10 kHz	25°C	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	$V_{O(PP)} = 5$ V, $A_{VD} = 10$ , f = 1 kHz, $R_L = 2$ k $\Omega$ , $R_S = 25$ $\Omega$	25°C	0.013%			0.013%				
$B_1$ Unity-gain bandwidth	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	9.4			9.4			MHz	
$B_{OM}$ Maximum output-swing bandwidth	$V_{O(PP)} = 4$ V, $A_{VD} = -1$ , $R_L = 2$ k $\Omega$ , $C_L = 25$ pF	25°C	2.8			2.8			MHz	
$\phi_m$ Phase margin at unity gain	$V_I = 10$ mV, $R_L = 2$ k $\Omega$ , $C_L = 25$ pF, See Figure 2	25°C	56°			56°				

† Full range is 40°C to 85°C.

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

PARAMETER	TEST CONDITIONS	$T_A$ †	TLE2071I			TLE2071AI			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
$V_{IO}$ Input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50 \Omega$	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	$\mu V/^\circ C$		
$I_{IO}$ Input offset current	$V_{IC} = 0, V_O = 0, \text{See Figure 4}$	25°C	6	100		6	100	pA		
		Full range		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				
	$I_O = -2 \text{ mA}$	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	80			80				

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



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**electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 15$  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	1.7	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		

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

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	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	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	28 55			28 55			nV/ $\sqrt{\text{Hz}}$
		f = 10 kHz	11.6 17			11.6 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, $A_{VD} = 10$ , 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°			

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

# TLE2071, TLE2071A, TLE2071Y

## EXCALIBUR LOW-NOISE HIGH-SPEED

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electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5$  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	0.34	4		0.3	2	mV		
		Full range			9.2		7.2			
$\alpha_{VIO}$ Temperature coefficient of input offset voltage		Full range	3.2	29*		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			20		20	nA		
$I_{IB}$ Input bias current		25°C	15	175		15	175	pA		
		Full range			65		65	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				

\*On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

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



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

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	1.6	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			

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

PARAMETER	TEST CONDITIONS	$T_A$ †	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*			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	28	55*		28	55*	$nV/\sqrt{\text{Hz}}$		
		f = 10 kHz	11.6	17*		11.6	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°			

\*On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

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



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**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	$V_{IC} = 0, V_O = 0, R_S = 50 \Omega$	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	$V_{IC} = 0, V_O = 0, \text{See Figure 4}$	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			65		65	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 <sup>12</sup>		10 <sup>12</sup>		$\Omega$		
$c_i$ 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-STD-883, Class B, this parameter is not production tested.

† Full range is -55°C to 125°C.





**TLE2071, TLE2071A, TLE2071Y**  
**EXCALIBUR LOW-NOISE HIGH-SPEED**  
**JFET-INPUT OPERATIONAL AMPLIFIERS**

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**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			
$I_{OS}$ 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  $125^\circ\text{C}$ .

**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	25°C	f = 10 Hz	28	55*	28	55*	nV/ $\sqrt{\text{Hz}}$		
			f = 10 kHz	11.6	17*	11.6	17*			
$V_{N(PP)}$ Peak-to-peak equivalent input noise voltage		f = 10 Hz to 10 kHz	25°C	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, $A_{VD} = 10$ , 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°				

\*On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

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

# TLE2071, TLE2071A, TLE2071Y EXCALIBUR LOW-NOISE HIGH-SPEED JFET-INPUT OPERATIONAL AMPLIFIERS

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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	

## PARAMETER MEASUREMENT INFORMATION

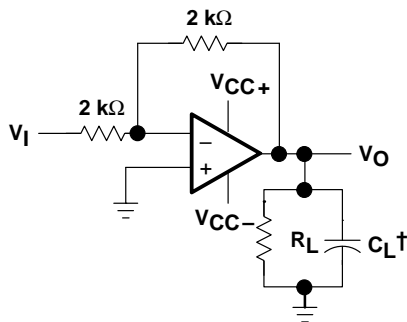


Figure 1. Slew-Rate Test Circuit

† Includes fixture capacitance

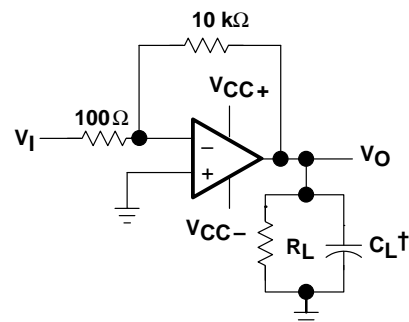


Figure 2. Unity-Gain Bandwidth and Phase-Margin Test Circuit

PARAMETER MEASUREMENT INFORMATION

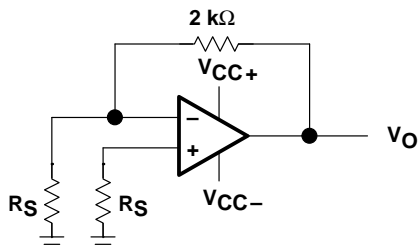


Figure 3. Noise-Voltage Test Circuit

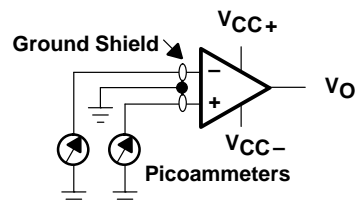


Figure 4. Input-Bias and Offset-Current Test Circuit

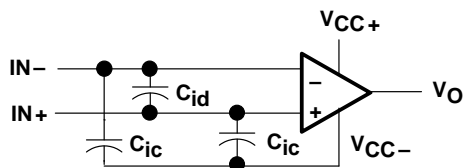


Figure 5. Internal Input Capacitance

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 TLE2071 and TLE2071A, accurate measurement of the bias 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.

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
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$I_{IB}$	Input bias current	vs Free-air temperature vs Supply voltage	8, 9 10
$V_{ICR}$	Common-mode input voltage range	vs Free-air temperature	11
$V_{ID}$	Differential input voltage	vs Output voltage	12, 13
$V_{OM+}$	Maximum positive peak output voltage	vs Output current vs Free-air temperature vs Supply voltage	14 16, 17 18

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**TYPICAL CHARACTERISTICS**

**Table of Graphs (Continued)**

			<b>FIGURE</b>
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		vs Free-air temperature	16, 17
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$V_O$	Output voltage	vs Settling time	20
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		vs Frequency	24, 25
CMRR	Common-mode rejection ratio	vs Frequency	26
		vs Free-air temperature	27
$k_{SVR}$	Supply-voltage rejection ratio	vs Frequency	28
		vs Free-air temperature	29
$I_{CC}$	Supply current	vs Supply voltage	30
		vs Free-air temperature	31
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$B_1$	Unity-gain bandwidth	vs Load capacitance	47
	Gain-bandwidth product	vs Free-air temperature	48
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$\phi_m$	Phase margin	vs Free-air temperature	51
		vs Supply voltage	52
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TYPICAL CHARACTERISTICS†

DISTRIBUTION OF TLE2071  
 INPUT OFFSET VOLTAGE

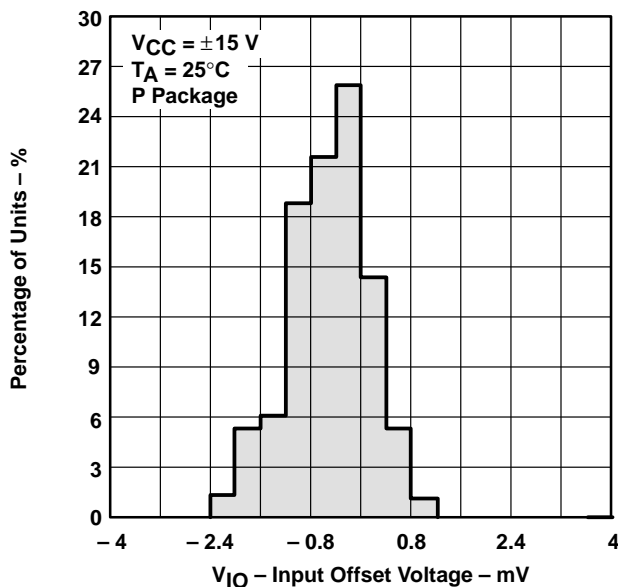


Figure 6

DISTRIBUTION OF TLE2071 INPUT OFFSET  
 VOLTAGE TEMPERATURE COEFFICIENT

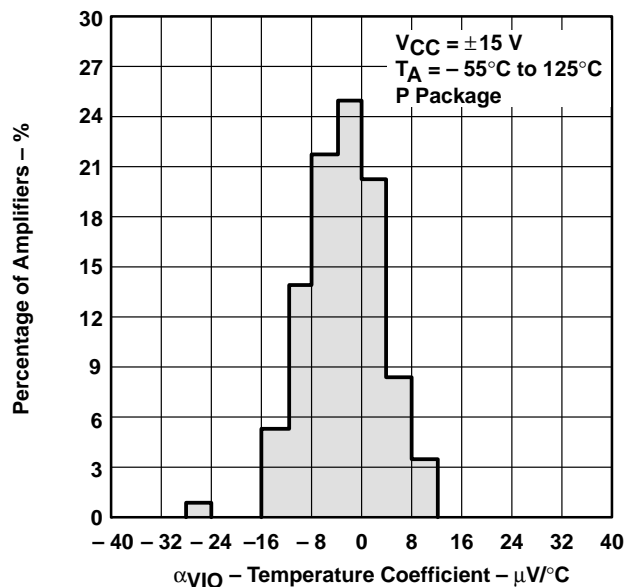


Figure 7

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

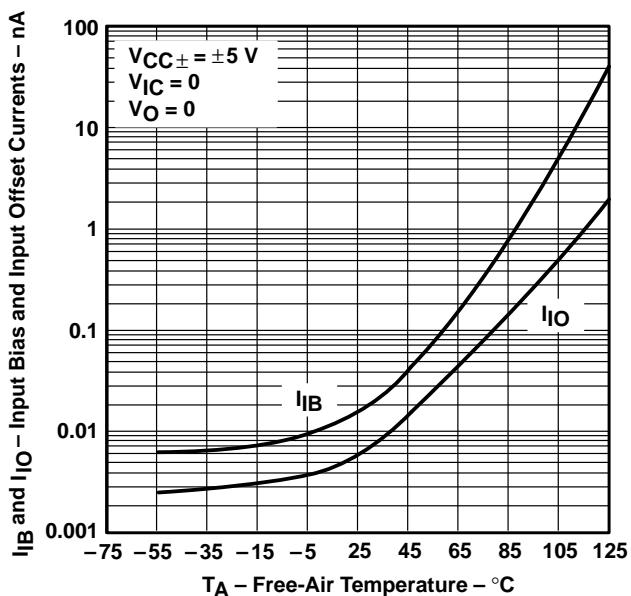


Figure 8

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

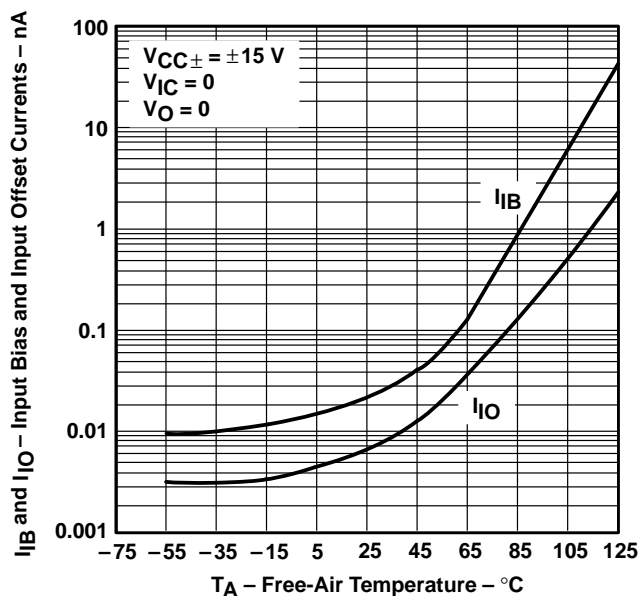
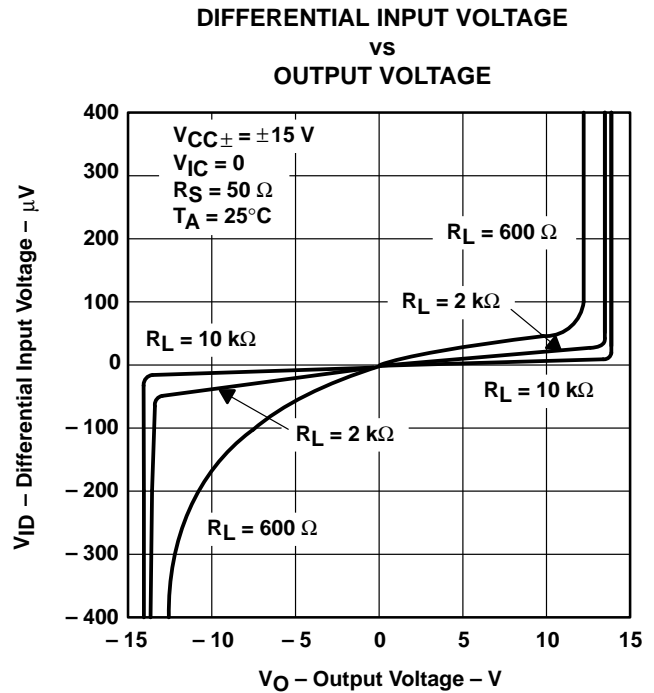
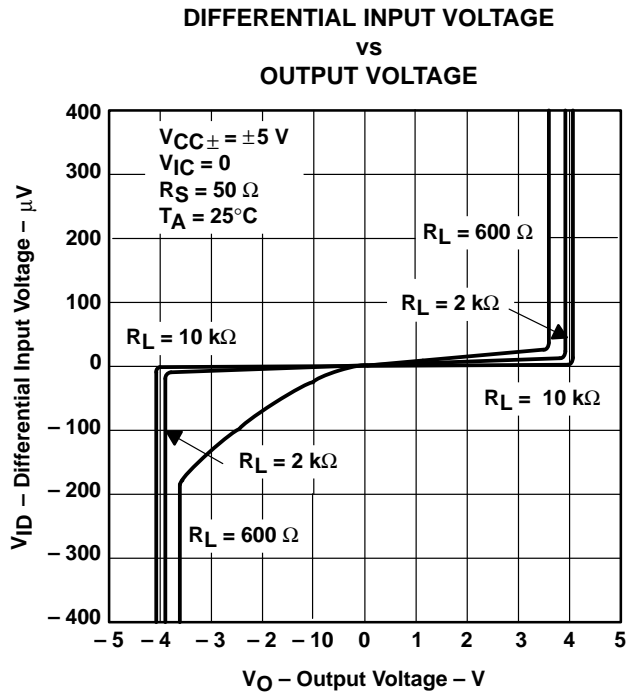
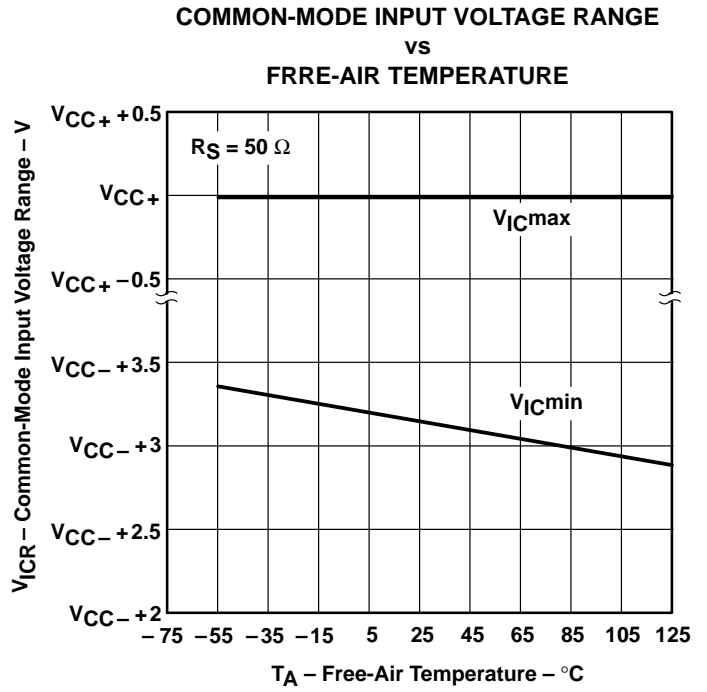
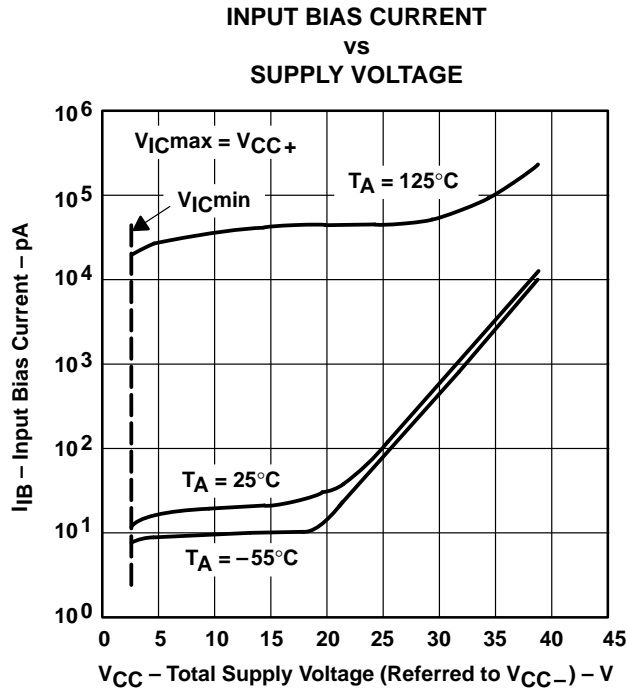


Figure 9

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

TYPICAL CHARACTERISTICS†



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

TYPICAL CHARACTERISTICS†

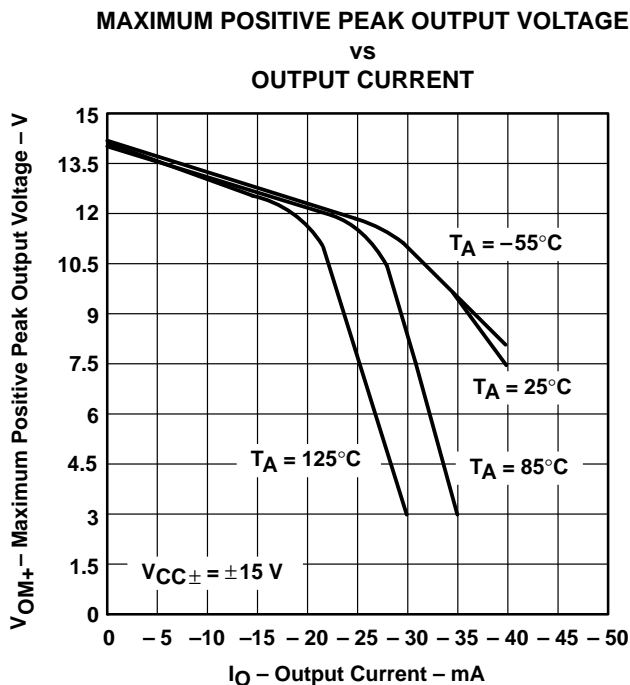


Figure 14

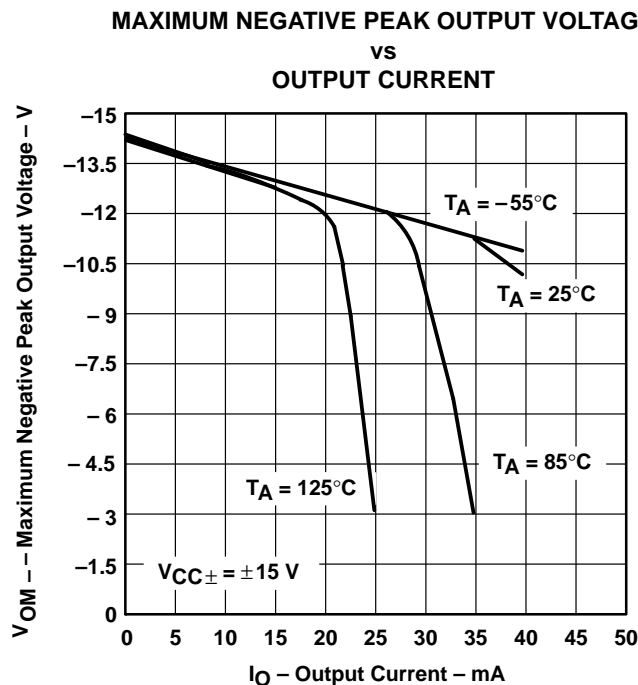


Figure 15

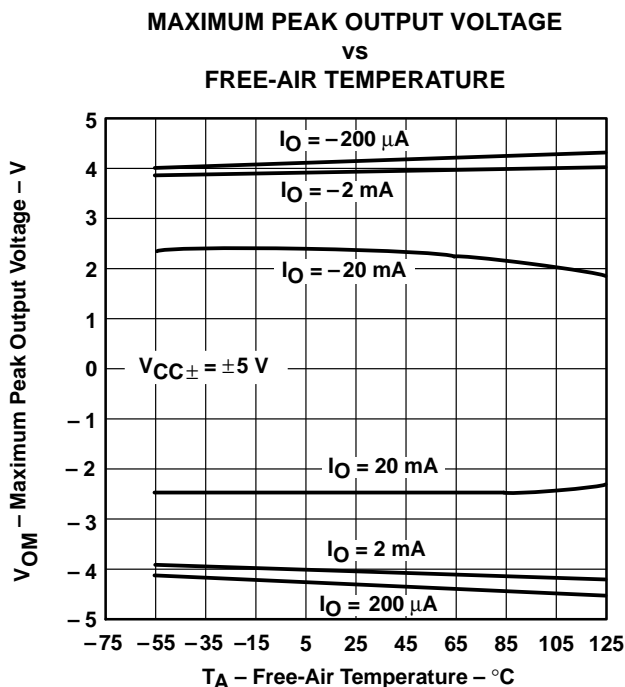


Figure 16

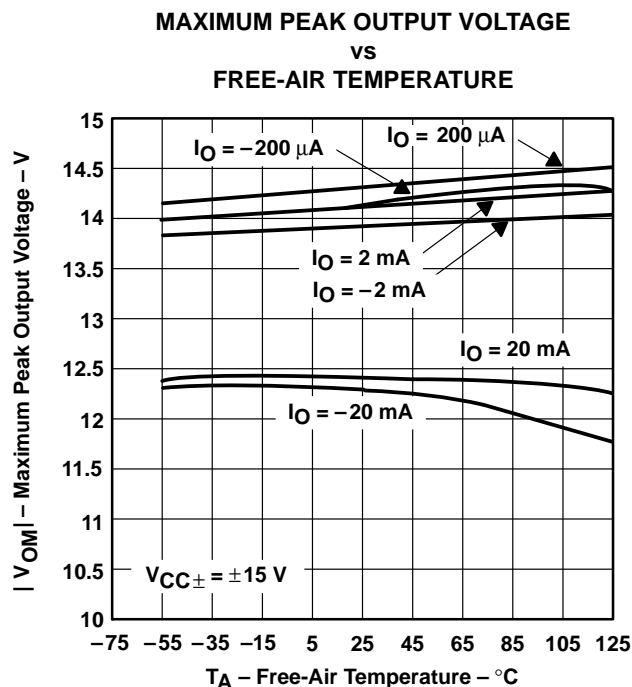


Figure 17

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

TYPICAL CHARACTERISTICS†

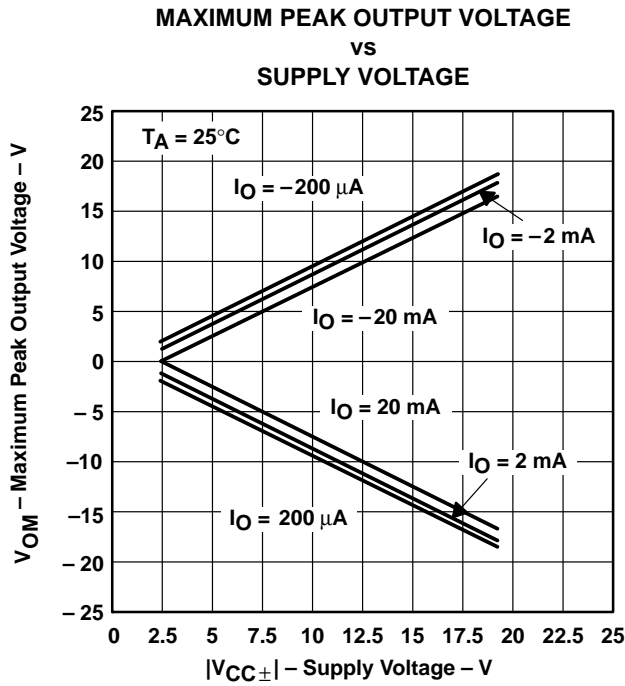


Figure 18

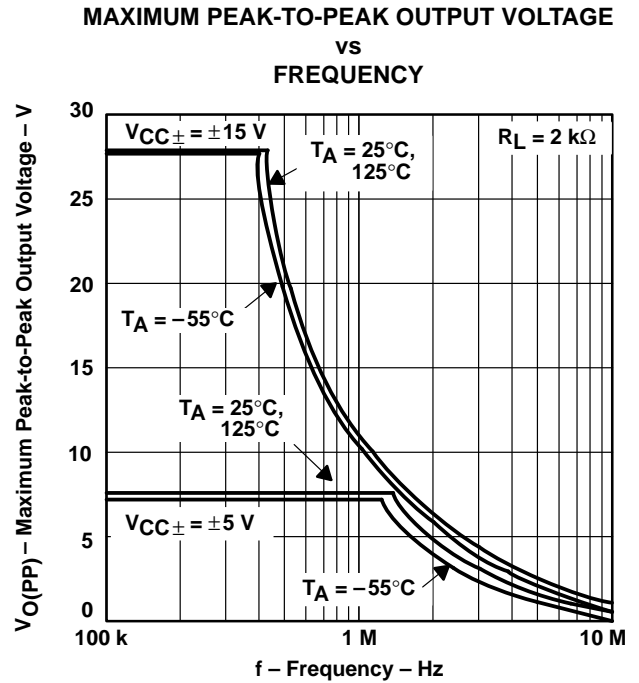


Figure 19

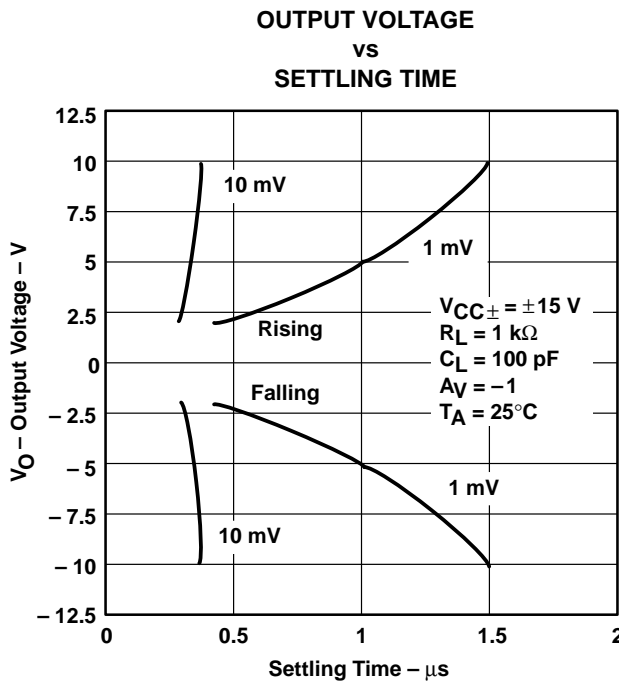


Figure 20

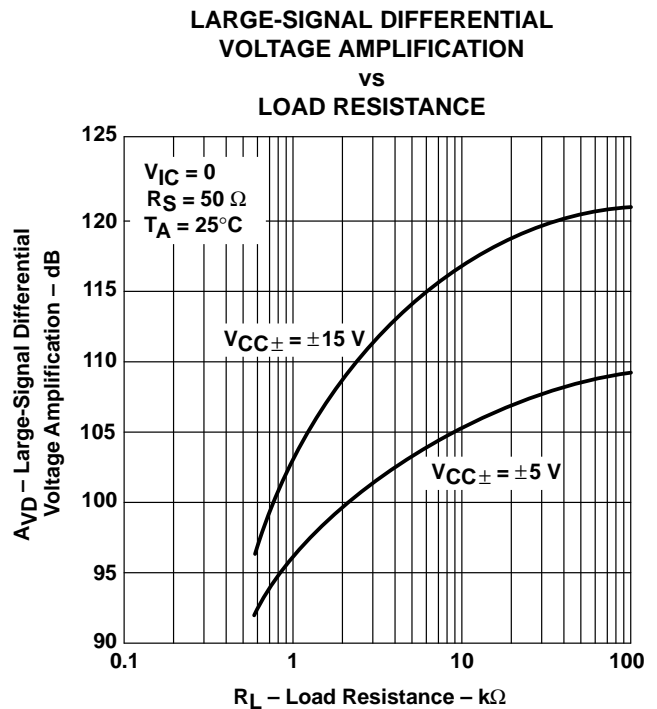


Figure 21

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



TYPICAL CHARACTERISTICS†

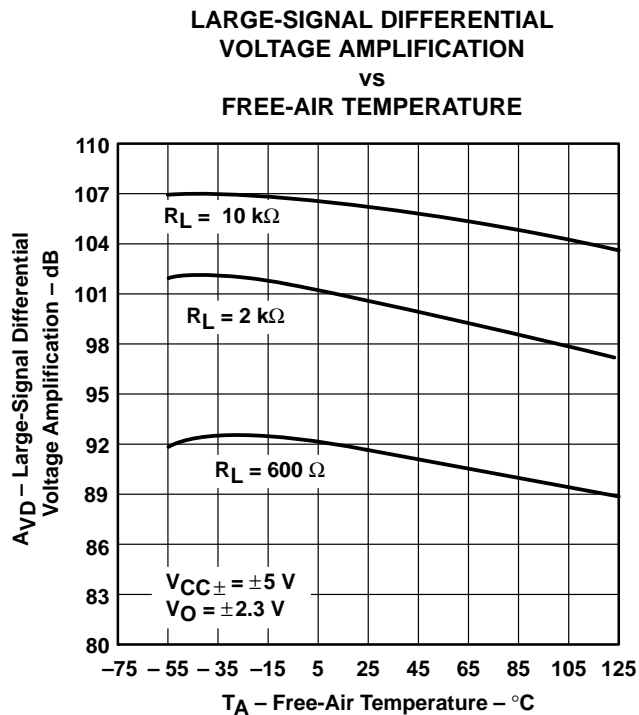


Figure 22

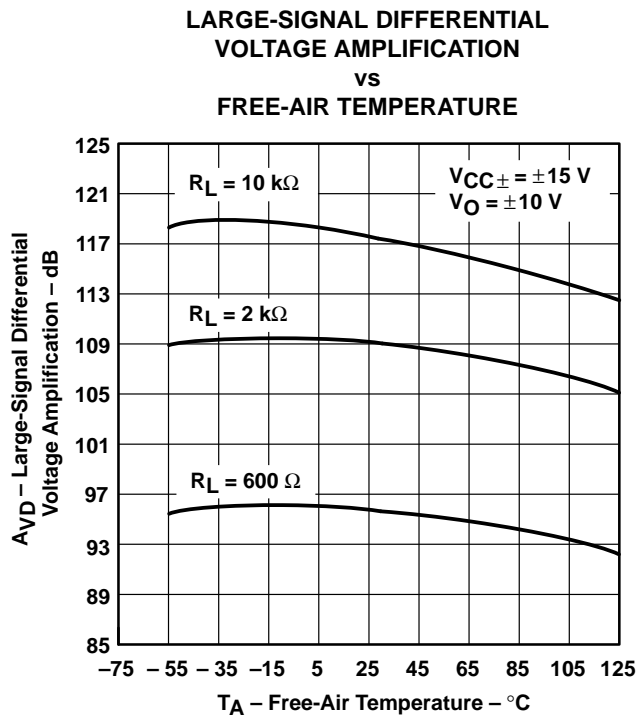


Figure 23

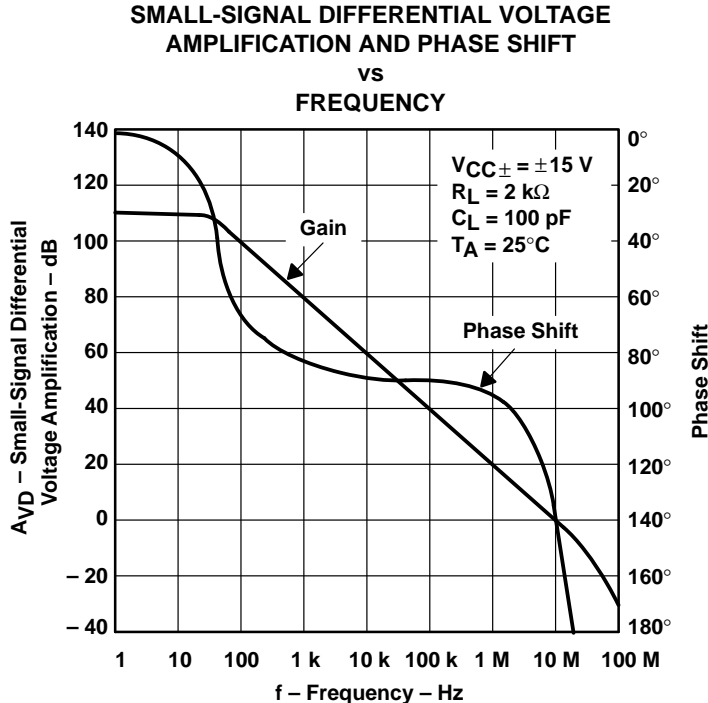


Figure 24

† 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†

SMALL-SIGNAL DIFFERENTIAL VOLTAGE  
 AMPLIFICATION AND PHASE SHIFT

vs  
 FREQUENCY

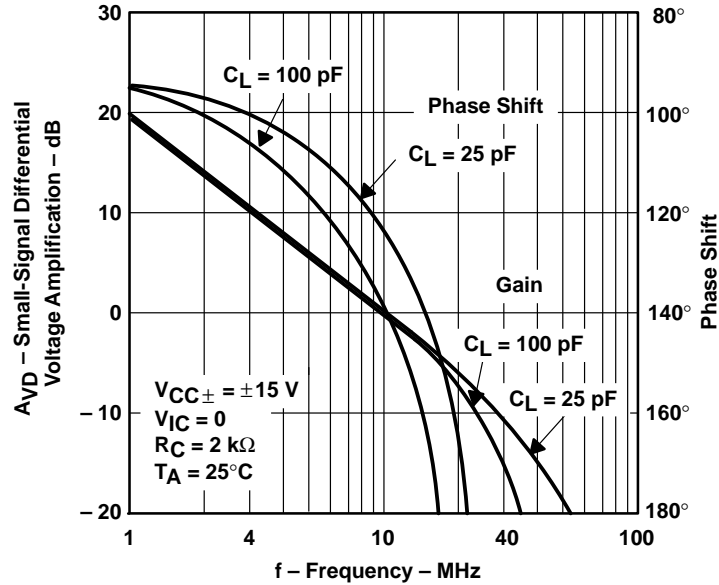


Figure 25

COMMON-MODE REJECTION RATIO  
 vs  
 FREQUENCY

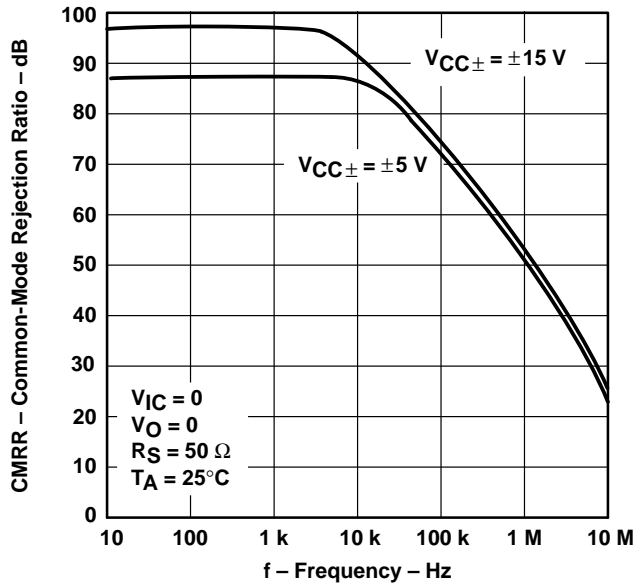


Figure 26

COMMON-MODE REJECTION RATIO  
 vs  
 FREE-AIR TEMPERATURE

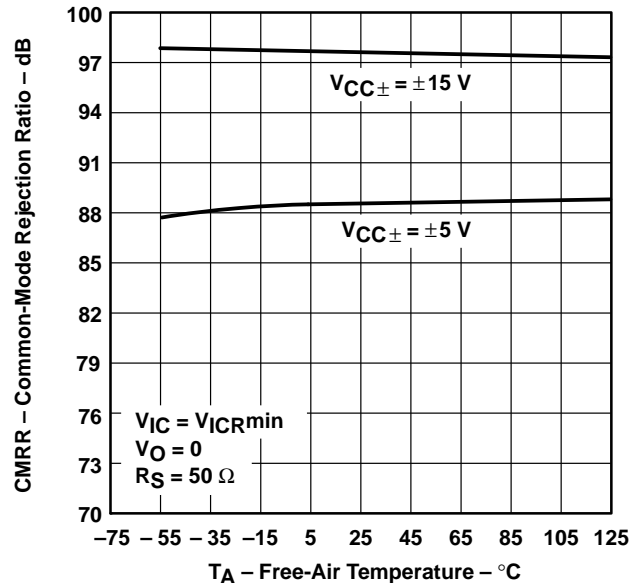


Figure 27

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



TYPICAL CHARACTERISTICS†

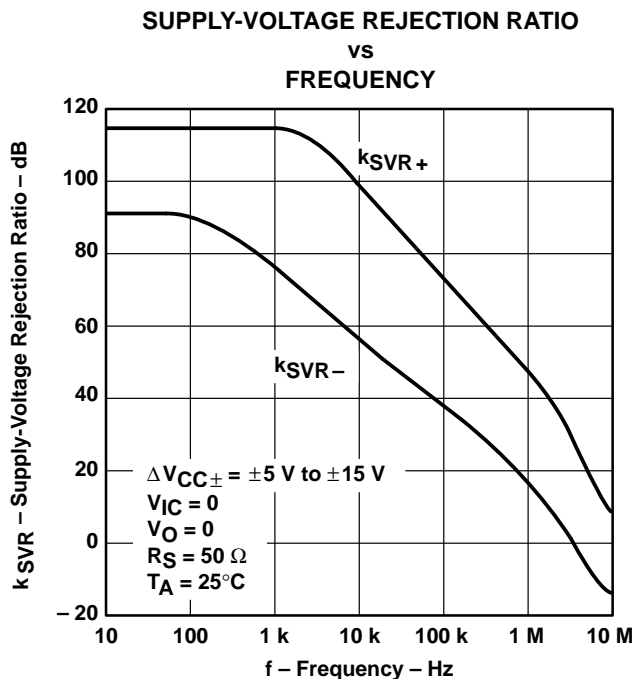


Figure 28

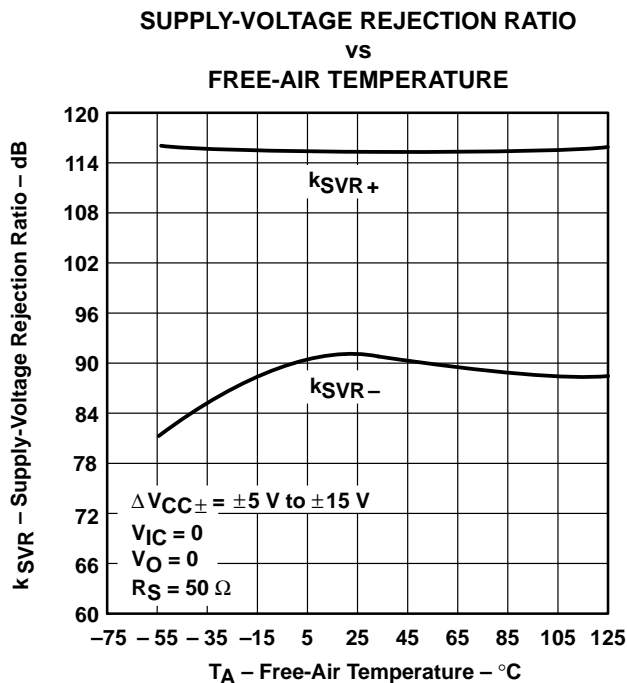


Figure 29

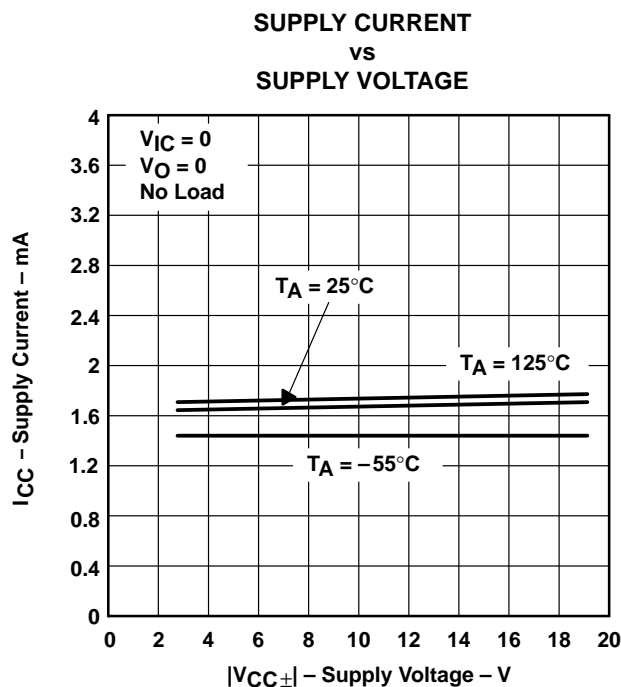


Figure 30

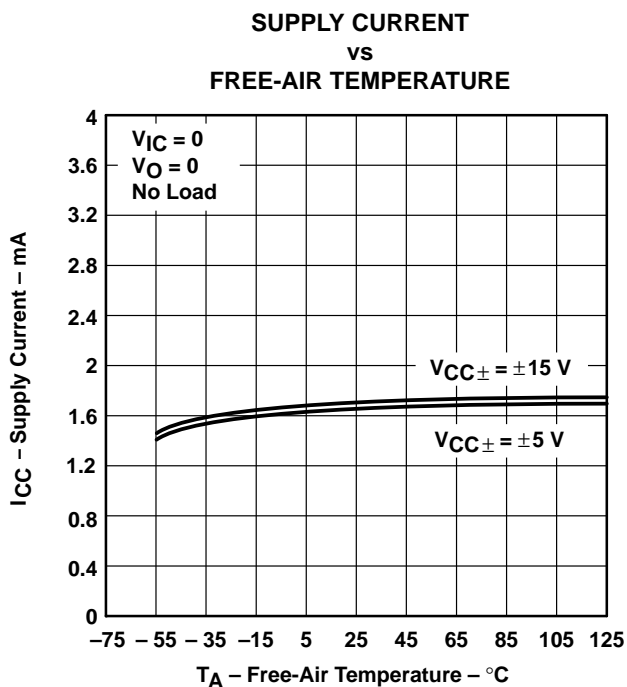


Figure 31

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

TYPICAL CHARACTERISTICS

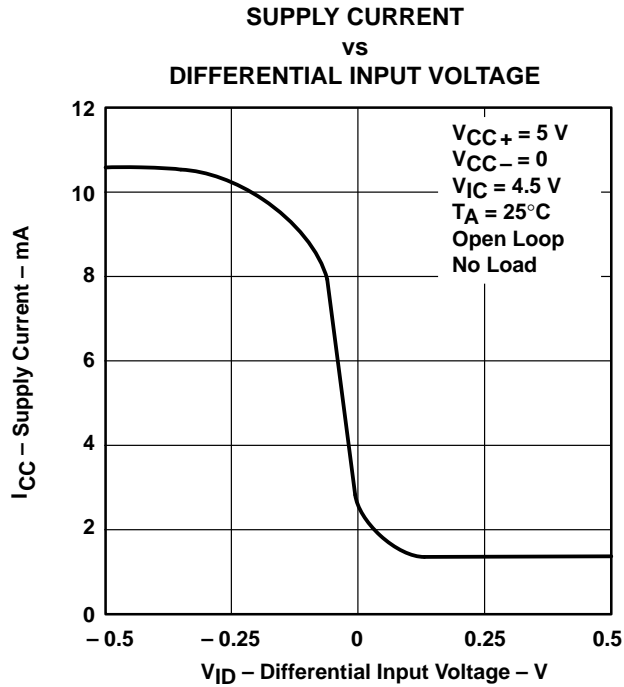


Figure 32

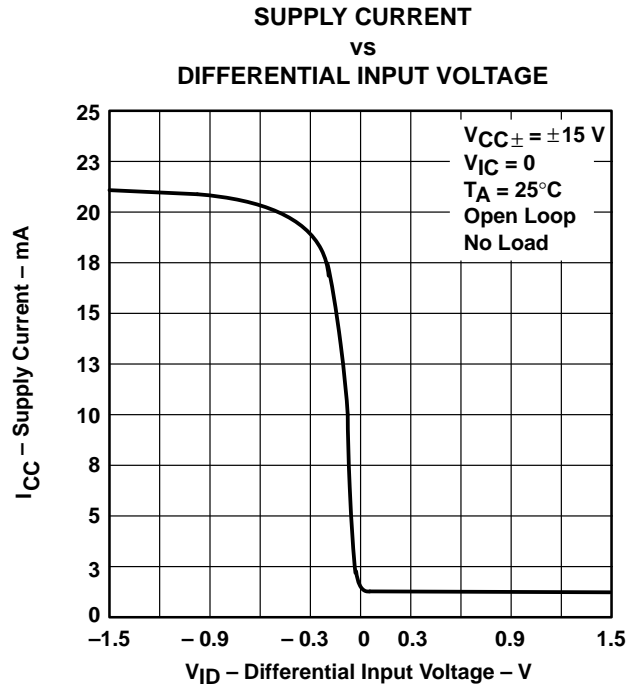


Figure 33

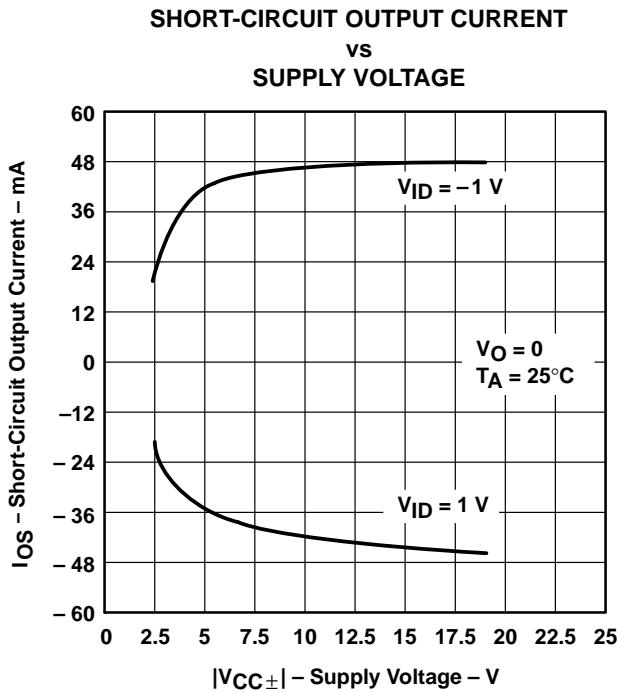


Figure 34

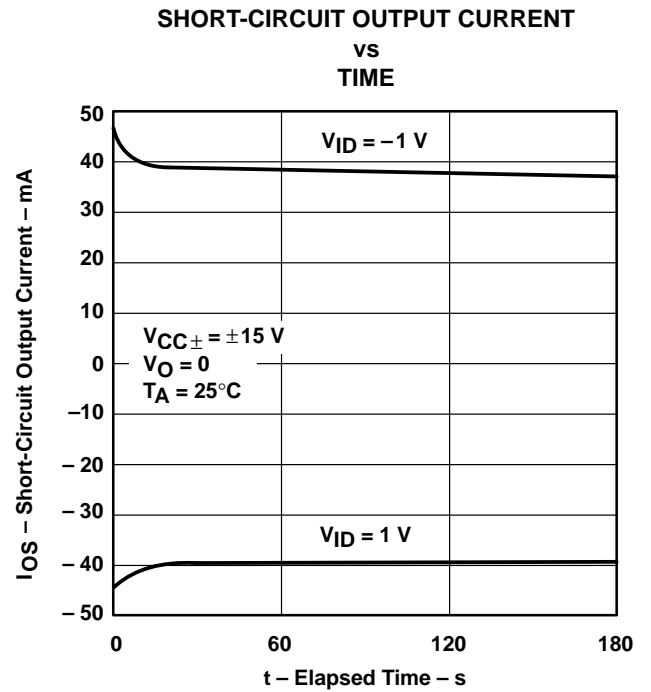


Figure 35

TYPICAL CHARACTERISTICS†

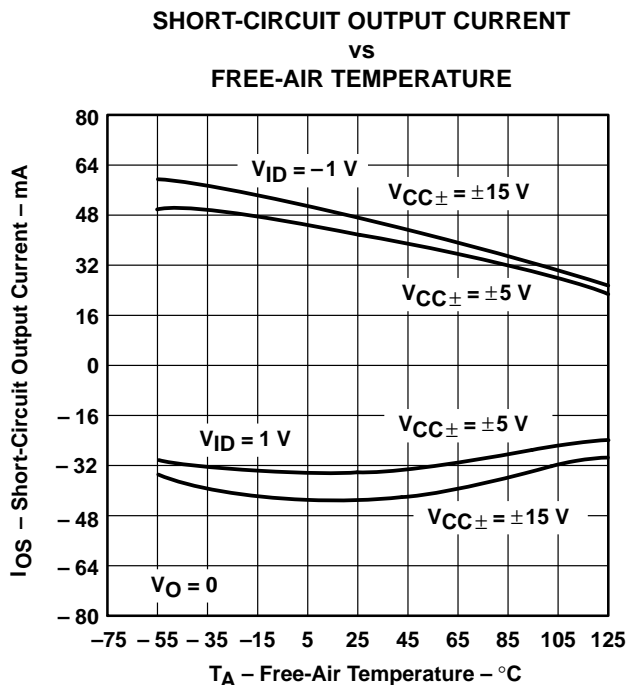


Figure 36

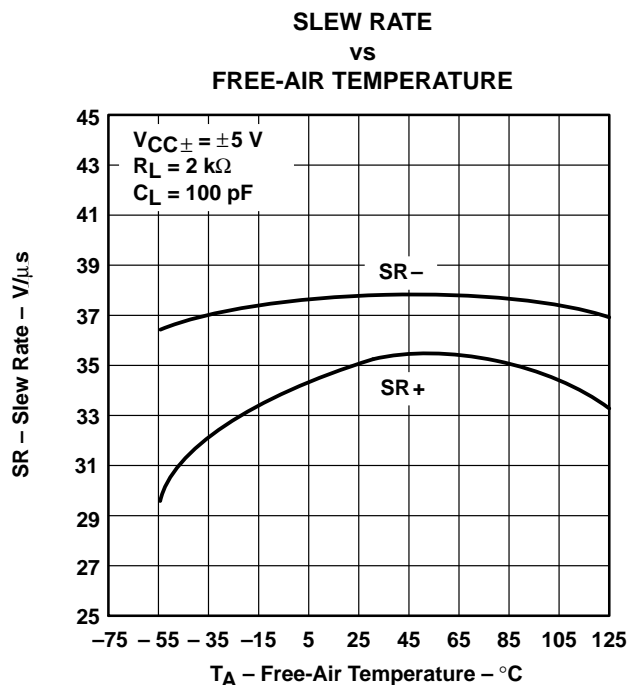


Figure 37

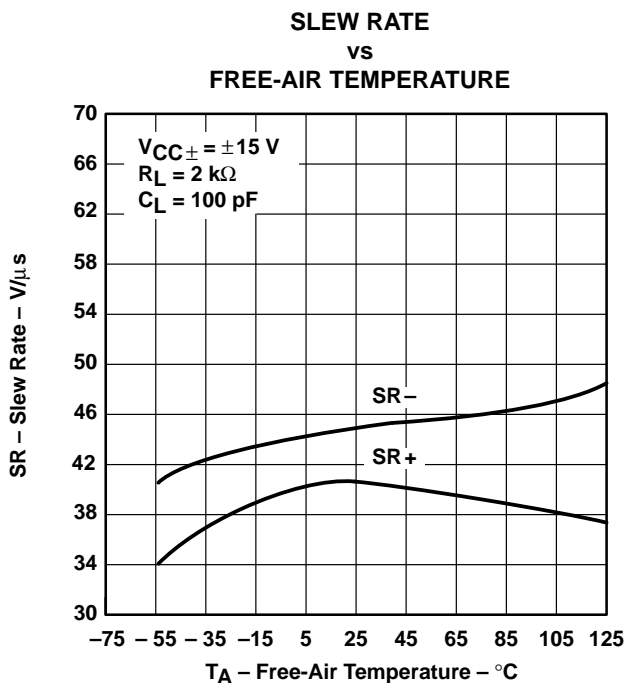


Figure 38

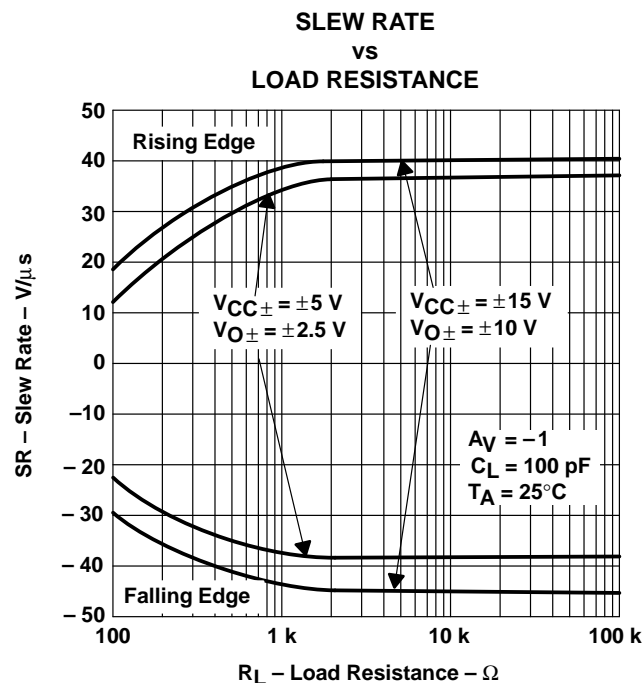
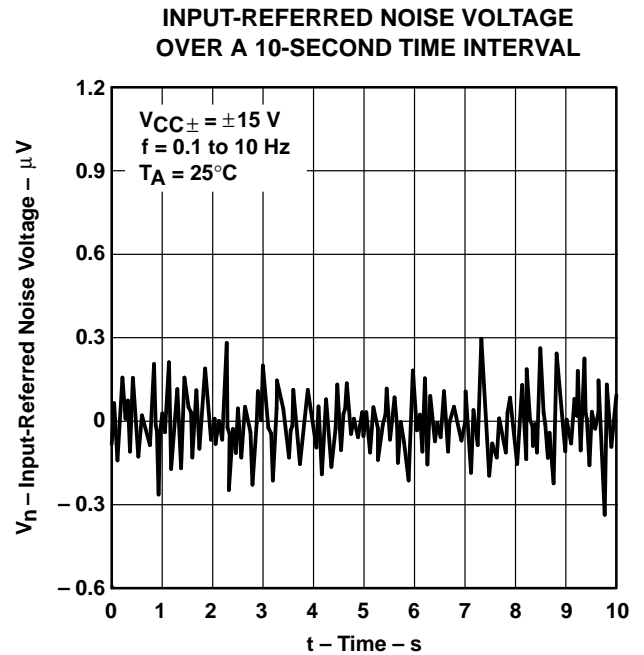
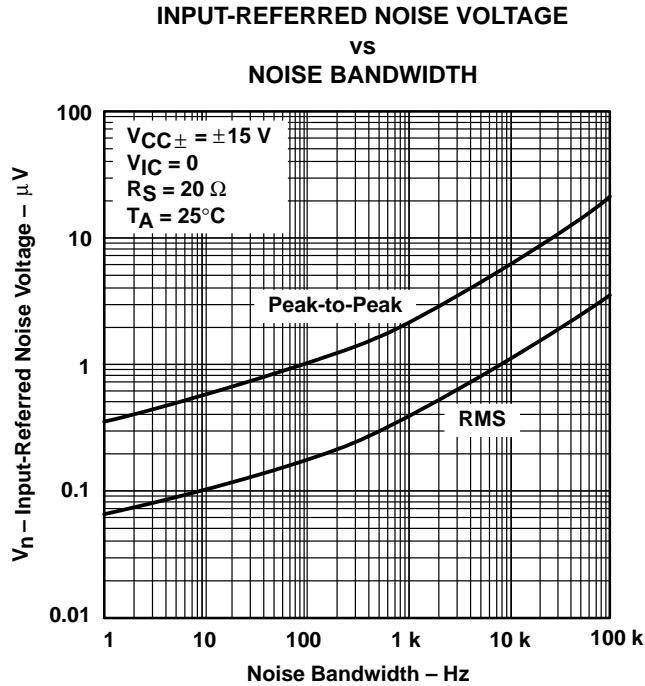
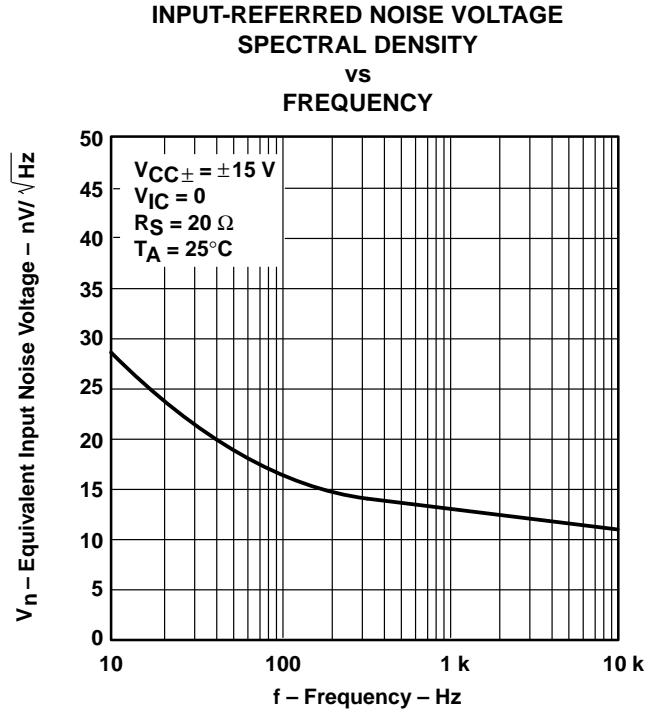
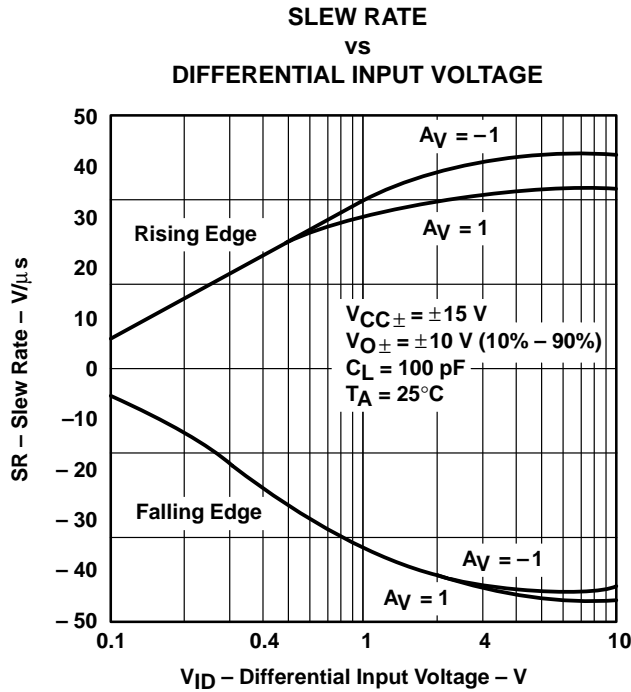


Figure 39

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

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

THIRD-OCTAVE SPECTRAL NOISE DENSITY  
 VS  
 FREQUENCY BANDS

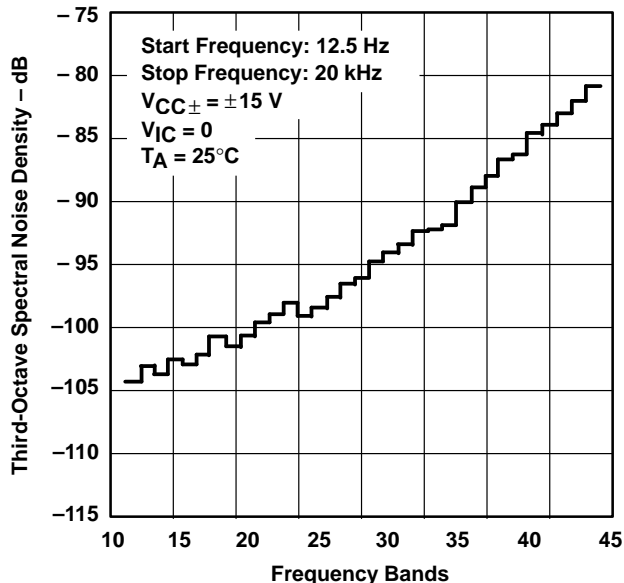


Figure 44

TOTAL HARMONIC DISTORTION PLUS  
 NOISE  
 VS  
 FREQUENCY

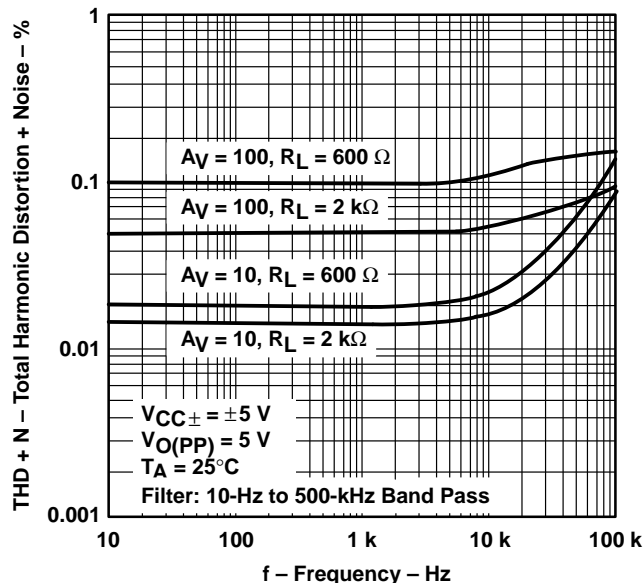


Figure 45

TOTAL HARMONIC DISTORTION PLUS NOISE  
 VS  
 FREQUENCY

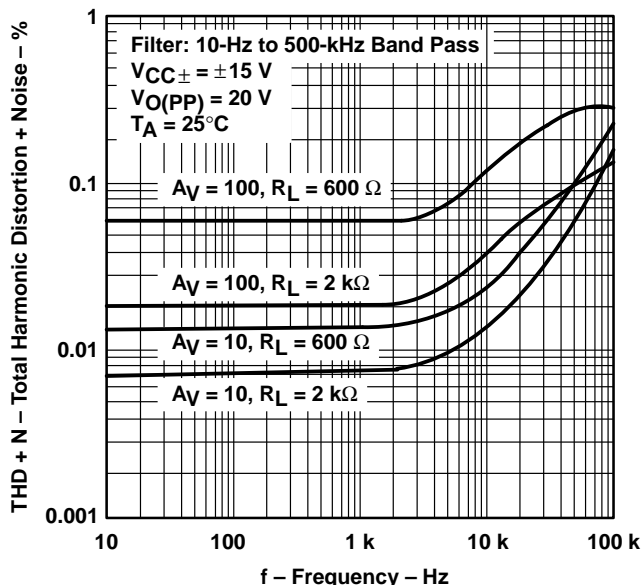


Figure 46

UNITY-GAIN BANDWIDTH  
 VS  
 LOAD CAPACITANCE

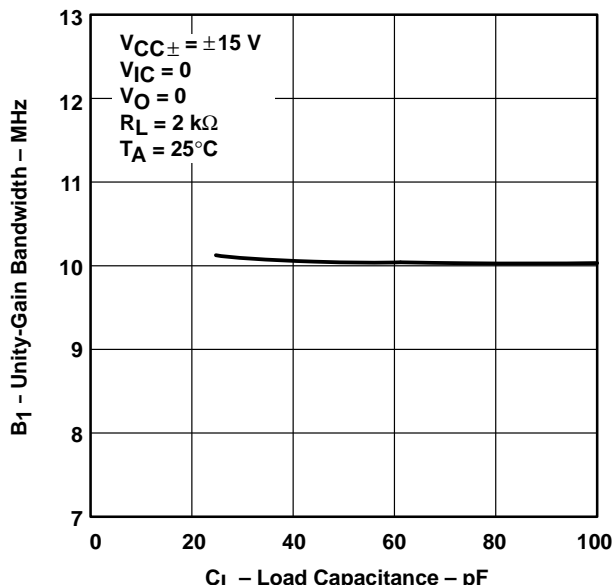
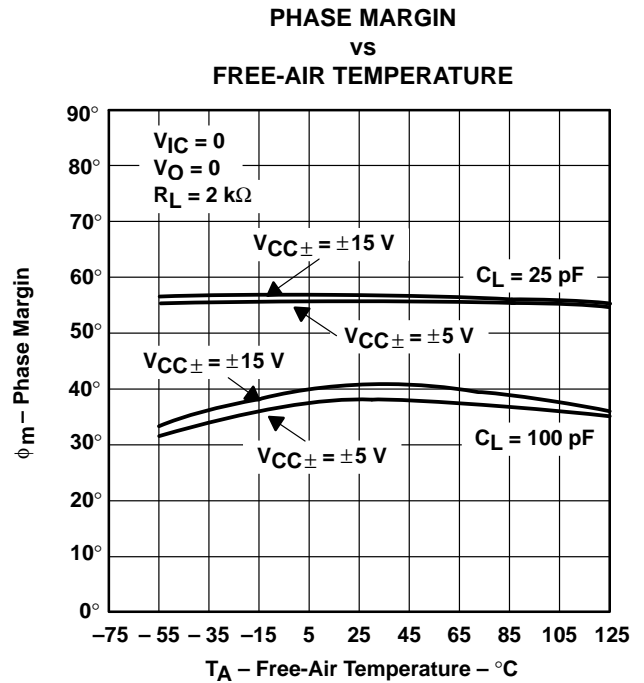
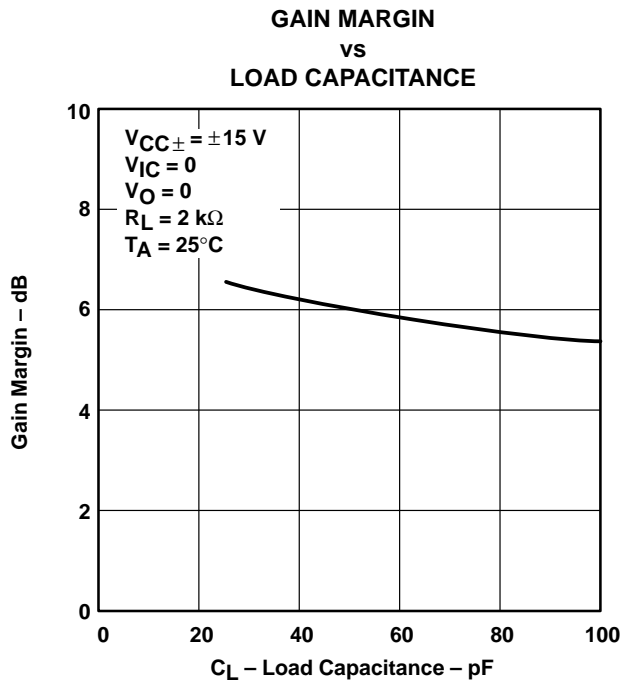
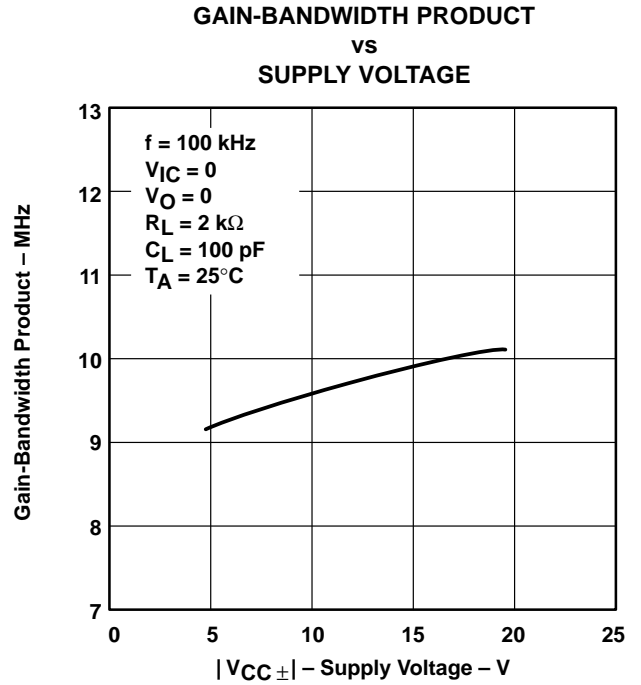
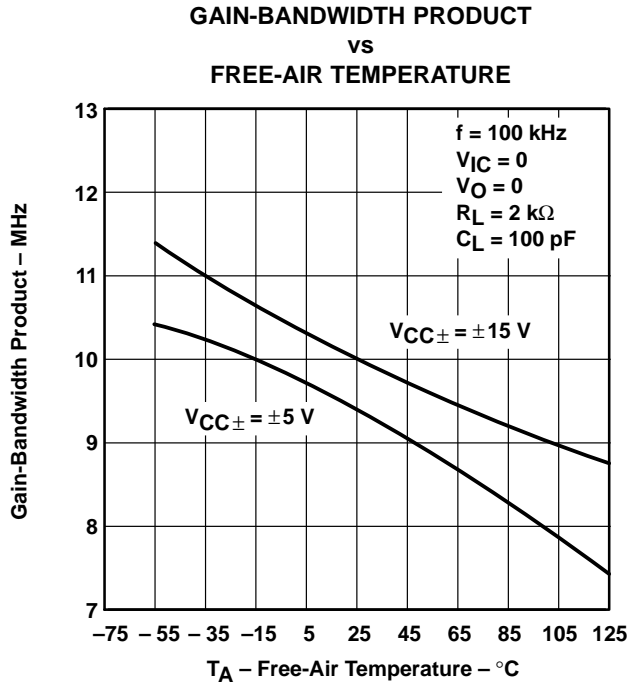


Figure 47

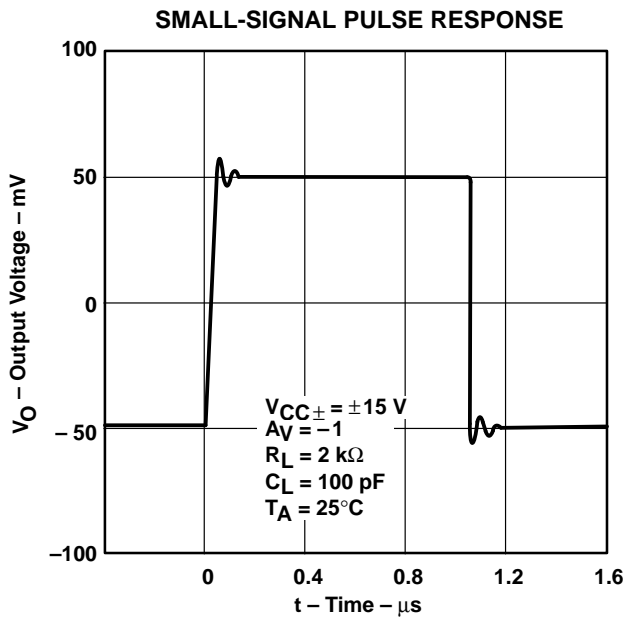
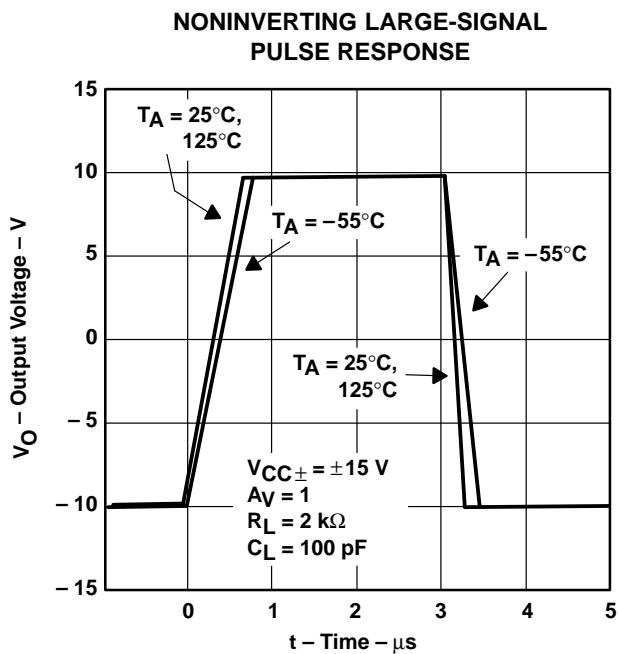
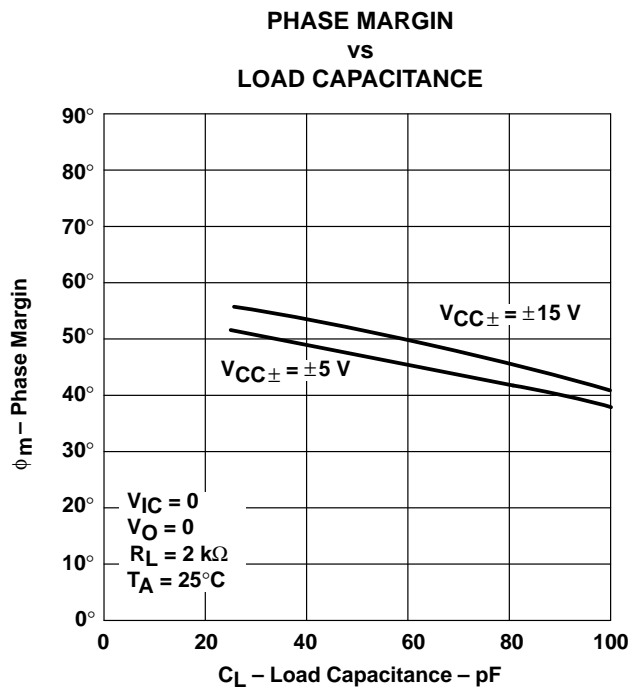
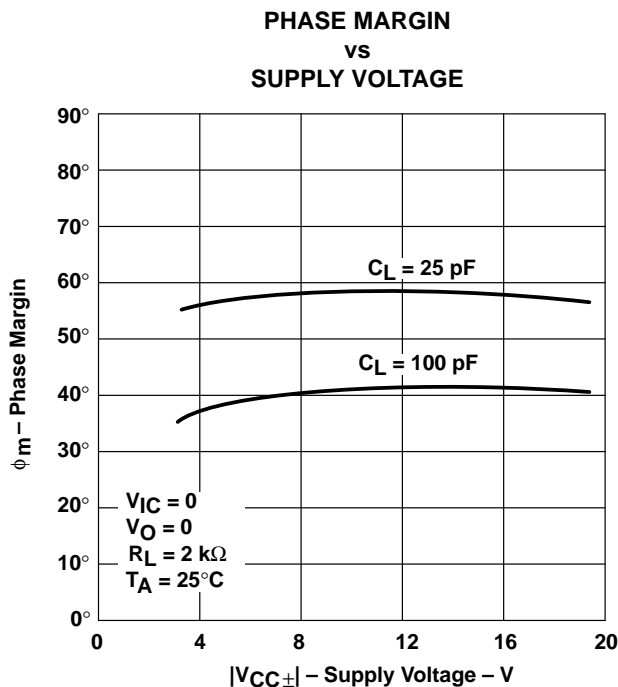
TYPICAL CHARACTERISTICS†



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



TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

CLOSED-LOOP OUTPUT IMPEDANCE  
VS  
FREQUENCY

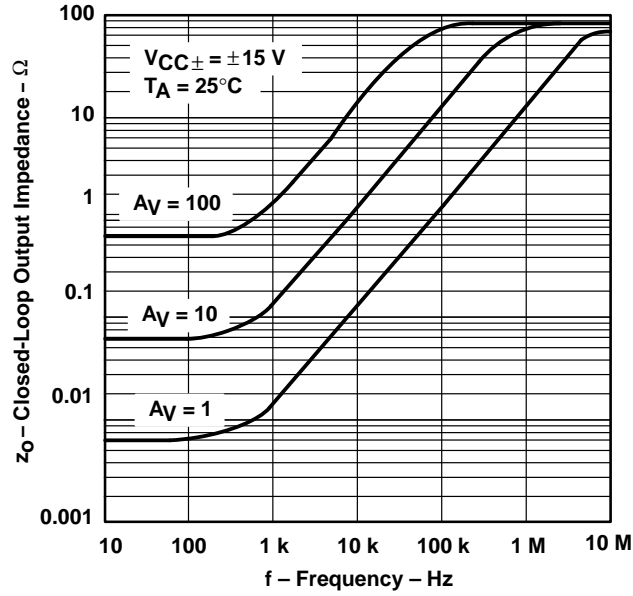


Figure 56

APPLICATION INFORMATION

macromodel information

Macromodel information provided was derived using *PSpice™ Parts™* model generation software. The Boyle macromodel (see Note 4) and subcircuit in Figure 57 were generated using the TLE2071 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).

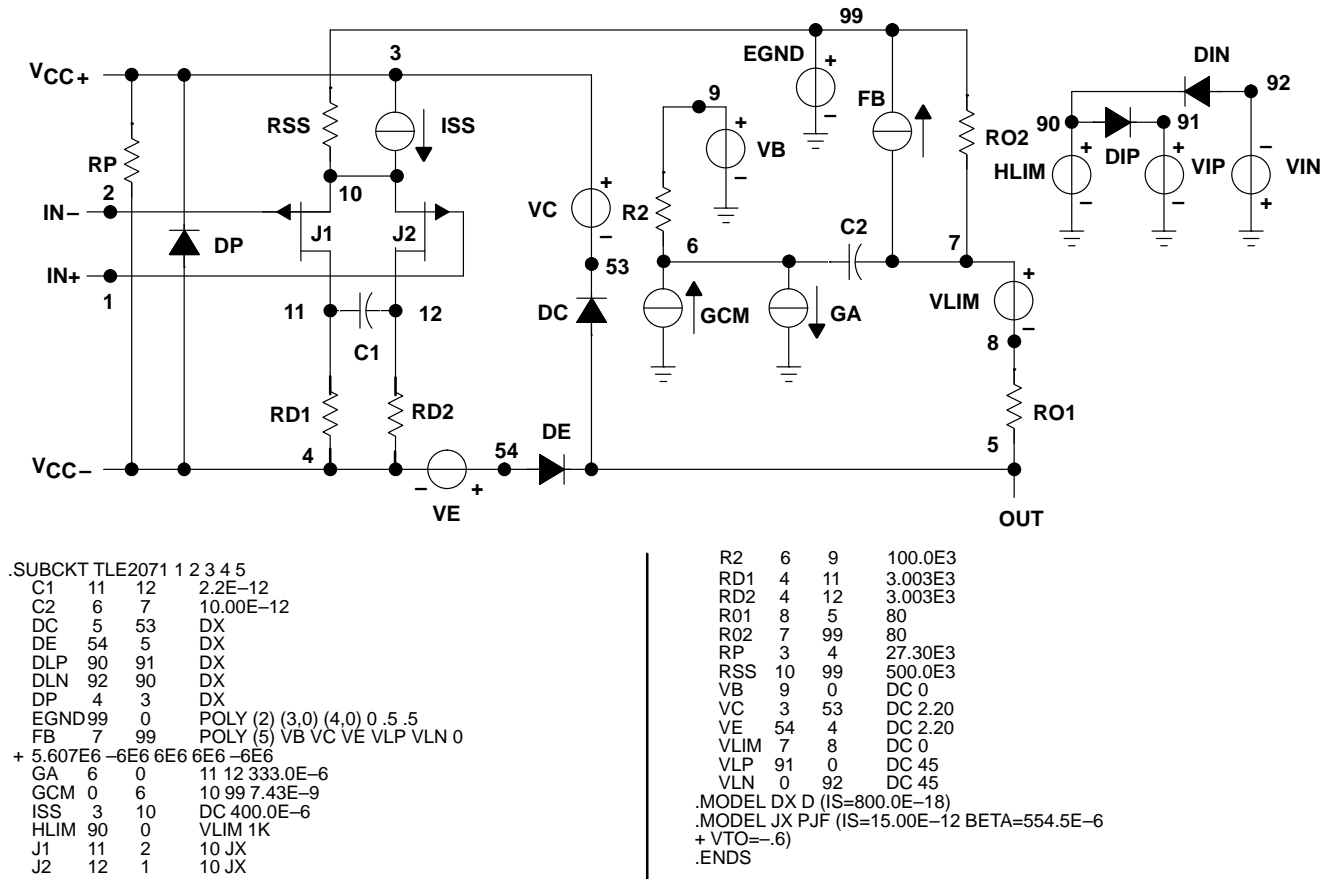


Figure 57. Boyle Macromodel and Subcircuit



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