- **25-V/μs Slew Rate Min**
- **Low Noise**
  17 nV/√Hz Max at f = 10 kHz
  11.6 nV/√Hz Typ at f = 10 kHz
- **High Gain-Bandwidth Product . . . 10 MHz**
- **±30-mA Minimum Short-Circuit Output Current**
- **Wide Supply-Voltage Range**
  ±2.25 V to ±19 V
- **Input Range Includes the Positive Supply**
- **Macromodel Included**
- **Fast Settling Time Using 10-V Step**
  400 ns to 10 mV Typ
  1.5 μs to 1 mV Typ

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

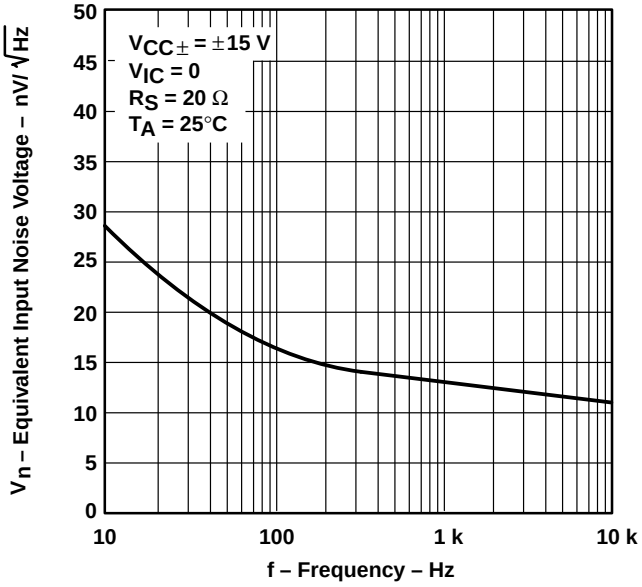


Figure 1

GAIN-BANDWIDTH PRODUCT vs FREE-AIR TEMPERATURE

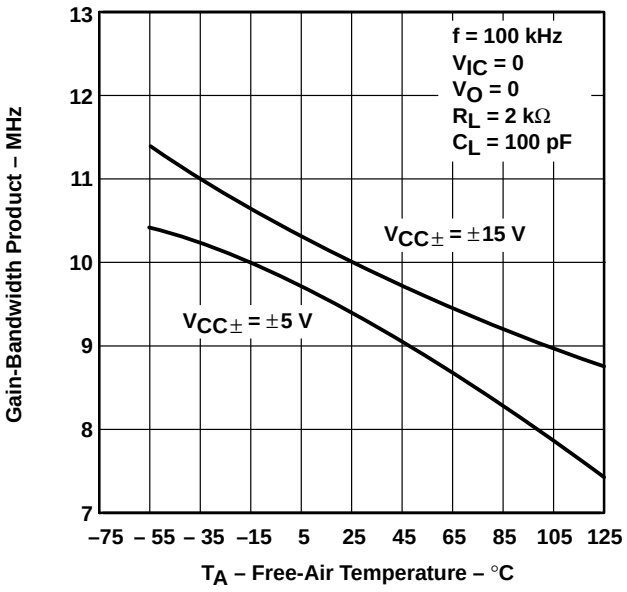


Figure 2

description

The TLE2074 and TLE2074A are low-noise, high-performance, high-speed, internally compensated JFET-input quadruple operational amplifiers built using Texas Instruments complementary bipolar Excalibur process. These devices combine low noise (see Figure 1) with outstanding output drive capability, high slew rate, and wide bandwidth (see Figure 2).

AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES				CHIP FORM (Y)‡
		SMALL OUTLINE (DW)†	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	
0°C to 70°C	3 mV 5 mV	TLE2074ACDW TLE2074CDW	—	—	TLE2074ACN TLE2074CN	— TLE2074Y
–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	—	—

† The DW packages are available taped and reeled. Add R suffix to device type (e.g., TLE2074ACDWR).
‡ Chip-form versions are tested at T_A = 25°C. For chip-form orders, contact your local TI sales office.

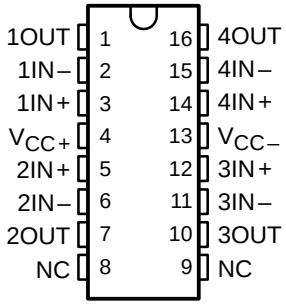
description (continued)

The design features a low audio-band noise of 11.6 nV/$\sqrt{\text{Hz}}$ typical at 10 kHz. This, coupled with a 25-V/μs minimum slew rate, results in the low distortion and high-power bandwidth necessary for high-fidelity audio applications. Settling time to 0.1% of a 10-V step (1-kΩ/100-pF load) is approximately 400 ns. Gain-bandwidth product is typically 10 MHz with an 8 MHz minimum. As such, the TLE2074 and TLE2074A offer significant speed and noise advantages at a low 1.6-mA typical supply current per channel.

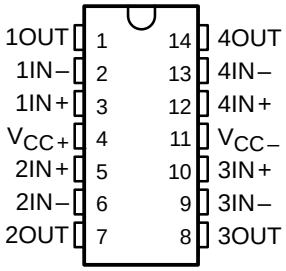
The input current characteristics traditionally associated with JFET-input amplifiers have been maintained. Input offset voltage is graded to a 7 mV and 4 mV maximum for the TLE2074 and TLE2074A, respectively. Typically, temperature coefficient of input offset voltage is 10.1 μV/°C and typical CMRR and k_{SVR} are 98 dB and 99 dB, respectively. Device performance is relatively independent of supply voltage over the wide ±2.25-V to ±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 a minimum of 30 mA and can sustain shorts to either supply. Care must be taken to ensure that maximum power dissipation is not exceeded.

Both the TLE2074 and TLE2074A are available in a wide variety of packages, including both the industry-standard 16-pin wide-body SOIC and chip form for high-density system applications. The C-suffix devices are characterized for operation from 0°C to 70°C, the I-suffix devices over the –40°C to 85°C range, and the M-suffix devices over the full military temperature range of –55°C to 125°C.

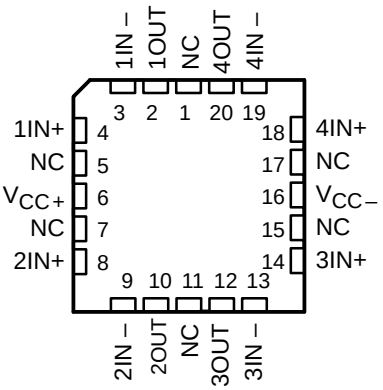
DW PACKAGE
(TOP VIEW)



J OR N PACKAGE
(TOP VIEW)

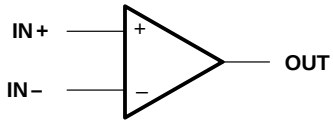


FK PACKAGE
(TOP VIEW)



NC – No internal connection

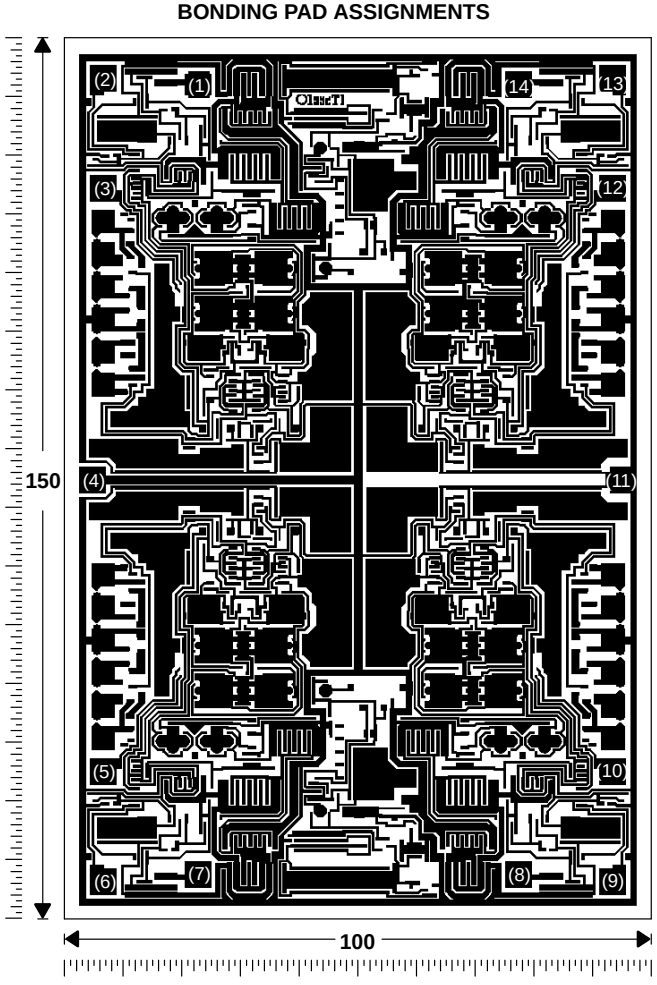
symbol

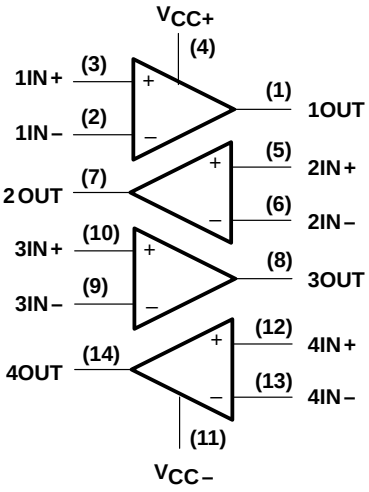


TLE2074Y chip information

This chip, when properly assembled, displays characteristics similar to the TLE2074. 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.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 15 TYPICAL

BONDING PADS: 4 × 4 MINIMUM

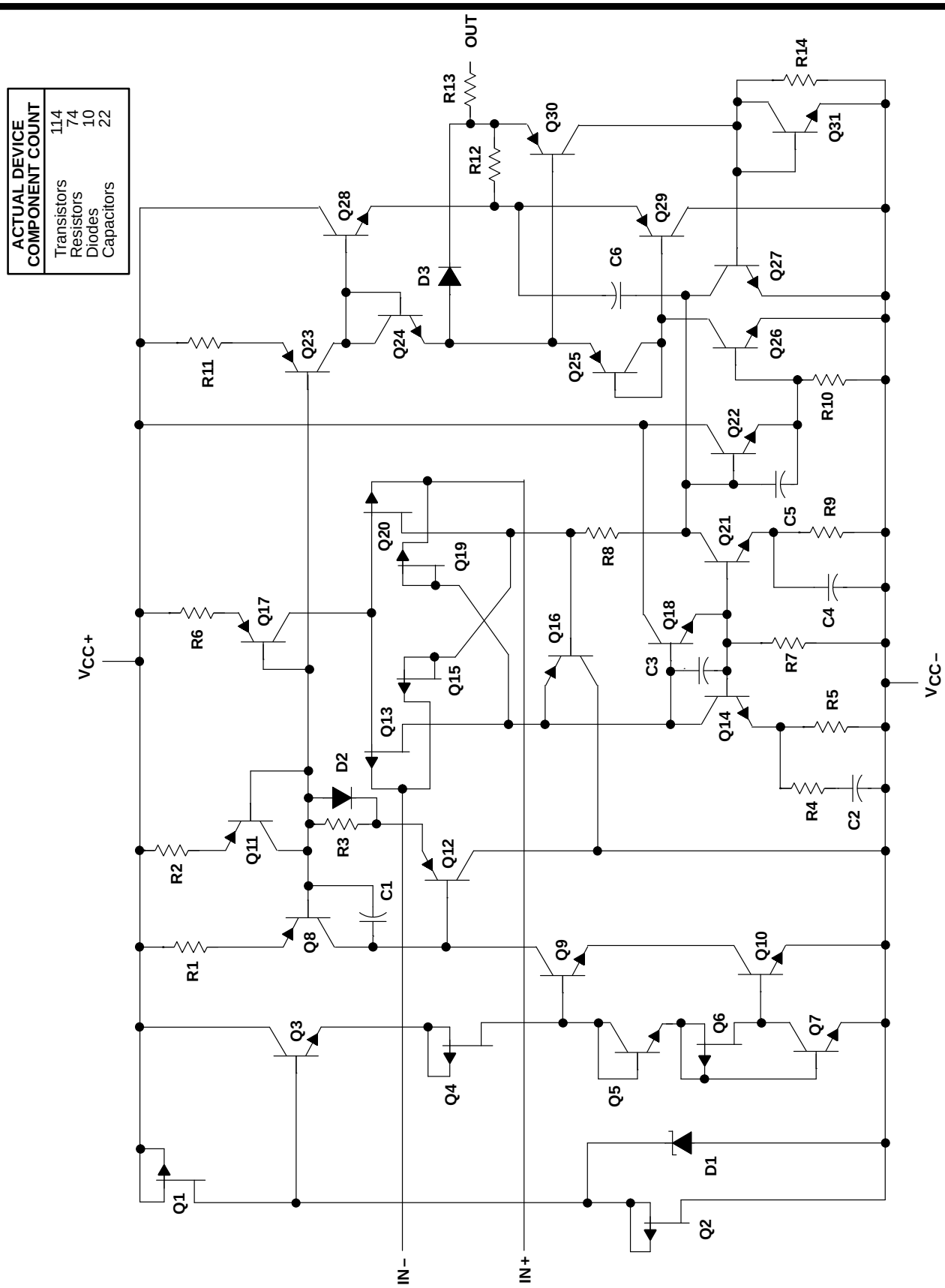
$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

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

equivalent schematic (each channel)



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: DW or N package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J 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 the noninverting input with respect to the inverting input.
3. 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.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING	$T_A = 125°C$ POWER RATING
DW	1025 mW	8.2 mW/°C	656 mW	533 mW	205 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
J	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
N	1150 mW	9.2 mW/°C	736 mW	598 mW	230 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}	$V_{CC\pm}$ = ±5 V	–0.9	5	–0.8	5	–0.8	5	V
	$V_{CC\pm}$ = ±15 V	–10.9	15	–10.8	15	–10.8	15	
Operating free-air temperature, T_A		0	70	–40	85	–55	125	°C

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±5 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 Ω		25°C		–1.6	5		–0.5	3	mV
					Full range			7.1			5.1	
α_{VIO}	Temperature coefficient of input offset voltage				Full range		10.1	30		10.1	30	μV/°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 Ω		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 μA		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 μA		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 = ± 2.3 V	R_L = 600 Ω	25°C	80	91		80	91		dB
					Full range	79			79			
				R_L = 2 kΩ	25°C	90	100		90	100		
					Full range	89			89			
				R_L = 10 kΩ	25°C	95	106		95	106		
					Full range	94			94			
r_i	Input resistance		V_{IC} = 0		25°C		10^{12}			10^{12}		Ω
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 MHz		25°C		80			80		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		25°C	70	89		70	89		dB
					Full range	68			68			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		25°C	82	99		82	99		dB
					Full range	80			80			

† Full range is 0°C to 70°C.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±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	
a_x	Crosstalk attenuation	V_{IC} = 0,	R_L = 2 kΩ	25°C		120			120		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C		–35			–35		mA
			V_{ID} = –1 V			45			45		

† Full range is 0°C to 70°C.

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

PARAMETER		TEST CONDITIONS		T_A†	TLE2074C			TLE2074AC			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)}$ = ±2.3 V, A_{VD} = –1, C_L = 100 pF,	R_L = 2 kΩ, See Figure 1	25°C		35			35		V/μs
				Full range	22			22			
SR–	Negative slew rate			25°C		38			38		V/μs
				Full range	22			22			
t_s	Settling time	A_{VD} = –1, 2-V step, R_L = 1 kΩ, C_L = 100 pF	To 10 mV	25°C		0.25			0.25		μs
			To 1 mV			0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω, See Figure 3	f = 10 Hz	25°C		28	55		28	55	nV/√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		μV
			f = 0.1Hz 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/√Hz
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 5 V, f = 1 kHz, R_S = 25 Ω	A_{VD} = 10, R_L = 2 kΩ,	25°C		0.013%			0.013%		
B_1	Unity-gain bandwidth	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		9.4			9.4		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 4 V, R_L = 2 kΩ ,	A_{VD} = –1, C_L = 25 pF	25°C		2.8			2.8		MHz
ϕ_m	Phase margin at unity gain	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		56°			56°		

† Full range is 0°C to 70°C.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±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, V_O = 0, R_S = 50 Ω		25°C		–1.6	5		–0.5	3	mV
					Full range			7.1			5.1	
α_{VIO}	Temperature coefficient of input offset voltage				Full range		10.1	30		10.1	30	µV/°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 Ω		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 µA		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 µA		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 = ± 10 V	R_L = 600 Ω	25°C	80	96		80	96		dB
					Full range	79			79			
				R_L = 2 kΩ	25°C	90	109		90	109		
					Full range	89			89			
				R_L = 10 kΩ	25°C	95	118		95	118		
					Full range	94			94			
r_i	Input resistance		V_{IC} = 0		25°C		10^{12}			10^{12}		Ω
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		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		25°C	80	98		80	98		dB
					Full range	79			79			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		25°C	82	99		82	99		dB
					Full range	81			81			

† Full range is 0°C to 70°C.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 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	6.5	7.5	5.2	6.5	7.5	mA
				Full range			7.5			7.5	
	Crosstalk attenuation	V_{IC} = 0,	R_L = 2 kΩ	25°C		120			120		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	–30	–45		–30	–45		mA
			V_{ID} = –1 V		30	48		30	48		

† Full range is 0°C to 70°C.

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

PARAMETER		TEST CONDITIONS		T_A†	TLE2074C			TLE2074AC			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)}$ = 10 V, R_L = 2 kΩ, See Figure 1	A_{VD} = –1, C_L = 100 pF,	25°C	25	40		25	40		V/µs
				Full range	22			22			
SR–	Negative slew rate			25°C	30	45		30	45		V/µs
				Full range	25			25			
t_s	Settling time	A_{VD} = –1, 10-V step, R_L = 1 kΩ, C_L = 100 pF	To 10 mV	25°C		0.4			0.4		µs
			To 1 mV			1.5			1.5		
V_n	Equivalent input noise voltage	R_S = 20 Ω, See Figure 3	f = 10 Hz	25°C		28	55		28	55	nV/√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		µV
			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/√Hz
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, f = 1 kHz, R_S = 25 Ω	A_{VD} = 10, R_L = 2 kΩ,	25°C		0.008%			0.008%		
B_1	Unity-gain bandwidth	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C	8	10		8	10		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, R_L = 2 kΩ,	A_{VD} = –1, C_L = 25 pF	25°C	478	637		478	637		kHz
ϕ_m	Phase margin at unity gain	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		57°			57°		

† Full range is 0°C to 70°C.

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

PARAMETER			TEST CONDITIONS		T_A†	TLE2074I			TLE2074AI			UNIT
						MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage		V_{IC} = 0, V_O = 0, R_S = 50 Ω		25°C		–1.6	5		–0.5	3	mV
					Full range			9			7	
α_{VIO}	Temperature coefficient of input offset voltage				Full range		10.1	30		10.1	30	µV/°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 Ω		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 µA		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 µA		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 = ± 2.3 V	R_L = 600 Ω	25°C	80	91		80	91		dB
					Full range	79			79			
				R_L = 2 kΩ	25°C	90	100		90	100		
					Full range	89			89			
				R_L = 10 kΩ	25°C	95	106		95	106		
					Full range	94			94			
r_i	Input resistance		V_{IC} = 0		25°C		10^{12}			10^{12}		Ω
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 MHz		25°C		80			80		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		25°C	70	89		70	89		dB
					Full range	68			68			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		25°C	82	99		82	99		dB
					Full range	80			80			

† Full range is –40°C to 85°C.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±5 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	6.3	7.5	5.2	6.3	7.5	mA
				Full range			7.5			7.5	
	Crosstalk attenuation	V_{IC} = 0,	R_L = 2 kΩ	25°C		120			120		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C		–35			–35		mA
			V_{ID} = –1 V			45			45		

† Full range is –40°C to 85°C.

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

PARAMETER		TEST CONDITIONS		T_A†	TLE2074I			TLE2074AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)}$ = ±2.3 V, A_{VD} = –1, C_L = 100 pF,	R_L = 2 kΩ, See Figure 1	25°C		35			35		V/μs
				Full range	20			20			
SR–	Negative slew rate			25°C		38			38		V/μs
				Full range	20			20			
t_s	Settling time	A_{VD} = –1, 2-V step, R_L = 1 kΩ, C_L = 100 pF	To 10 mV	25°C		0.25			0.25		μs
			To 1 mV			0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω, See Figure 3	f = 10 Hz	25°C		28	55		28	55	nV/√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		μV
			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/√Hz
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 5 V, f = 1 kHz, R_S = 25 Ω	A_{VD} = 10, R_L = 2 kΩ,	25°C		0.013%			0.013%		
B_1	Unity-gain bandwidth	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		9.4			9.4		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 4 V, R_L = 2 kΩ ,	A_{VD} = –1, C_L = 25 pF	25°C		2.8			2.8		MHz
ϕ_m	Phase margin at unity gain	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		56°			56°		

† Full range is –40°C to 85°C.

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

PARAMETER			TEST CONDITIONS		T_A†	TLE2074I			TLE2074AI			UNIT
						MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage		V_{IC} = 0, V_O = 0, R_S = 50 Ω		25°C		–1.6	5		–0.5	3	mV
					Full range			9			7	
α_{VIO}	Temperature coefficient of input offset voltage				Full range		10.1	30		10.1	30	µV/°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 Ω		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 µA		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 µA		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 = ± 10 V	R_L = 600 Ω	25°C	80	96		80	96		dB
					Full range	79			79			
				R_L = 2 kΩ	25°C	90	109		90	109		
					Full range	89			89			
				R_L = 10 kΩ	25°C	95	118		95	118		
					Full range	94			94			
r_i	Input resistance		V_{IC} = 0		25°C		10^{12}			10^{12}		Ω
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		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		25°C	80	98		80	98		dB
					Full range	79			79			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		25°C	82	99		82	99		dB
					Full range	80			80			

† Full range is –40°C to 85°C.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±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 kΩ	25°C		120			120		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	–30	–45		–30	–45		mA
			V_{ID} = –1 V		30	48		30	48		

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

PARAMETER		TEST CONDITIONS		T_A†	TLE2074I			TLE2074AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)}$ = ±10 V, A_{VD} = –1, C_L = 100 pF,	R_L = 2 kΩ, See Figure 1	25°C	25	40		25	40		V/μs
				Full range	19			19			
SR–	Negative slew rate			25°C	30	45		30	45		V/μs
				Full range	22			22			
t_s	Settling time	A_{VD} = –1, 10-V step, R_L = 1 kΩ, C_L = 100 pF	To 10 mV	25°C		0.4			0.4		μs
			To 1 mV			1.5			1.5		
V_n	Equivalent input noise voltage	R_S = 20 Ω, See Figure 3	f = 10 Hz	25°C		28	55		28	55	nV/√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		μV
			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/√Hz
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, f = 1 kHz, R_S = 25 Ω	A_{VD} = 10, R_L = 2 kΩ,	25°C		0.008%			0.008%		
B_1	Unity-gain bandwidth	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C	8	10		8	10		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, R_L = 2 kΩ,	A_{VD} = –1, C_L = 25 pF	25°C	478	637		478	637		kHz
ϕ_m	Phase margin at unity gain	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		57°			57°		

† Full range is –40°C to 85°C.

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

PARAMETER			TEST CONDITIONS		T_A†	TLE2074M			TLE2074AM			UNIT
						MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage		V_{IC} = 0, V_O = 0, R_S = 50Ω		25°C		–1.6	5		–0.5	3	mV
					Full range			10.5			8.5	
α_{VIO}	Temperature coefficient of input offset voltage				Full range		10.1	30*		10.1	30*	µV/°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		20	175		20	175	pA
					Full range			65			65	nA
V_{ICR}	Common-mode input voltage range		R_S = 50 Ω		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 µA		25°C	3.8	4.1		3.8	4.1		V
					Full range	3.6			3.6			
			I_O = –2 mA		25°C	3.5	3.9		3.5	3.9		
					Full range	3.3			3.3			
			I_O = –20 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 µA		25°C	–3.8	–4.2		–3.8	–4.2		V
					Full range	–3.6			–3.6			
			I_O = 2 mA		25°C	–3.5	–4.1		–3.5	–4.1		
					Full range	–3.3			–3.3			
			I_O = 20 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 = ± 2.3 V	R_L = 600 Ω	25°C	80	91		80	91		dB
					Full range	78			78			
				R_L = 2 kΩ	25°C	90	100		90	100		
					Full range	88			88			
				R_L = 10 kΩ	25°C	95	106		95	106		
					Full range	93			93			
r_i	Input resistance		V_{IC} = 0		25°C		10^{12}			10^{12}		Ω
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 MHz		25°C		80			80		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		25°C	70	89		70	89		dB
					Full range	68			68			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		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.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±5 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	6.3	7.5	5.2	6.3	7.5	mA
				Full range			7.5			7.5	
	Crosstalk attenuation	V_{IC} = 0,	R_L = 2 kΩ	25°C		120			120		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C		–35			–35		mA
			V_{ID} = –1 V			45			45		

† Full range is –55°C to 125°C.

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

PARAMETER		TEST CONDITIONS		T_A†	TLE2074M			TLE2074AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)}$ = ±2.3 V, A_{VD} = –1, C_L = 100 pF,	R_L = 2 kΩ, See Figure 1	25°C		35			35		V/μs
				Full range	18*			18*			
SR–	Negative slew rate			25°C		38			38		V/μs
				Full range	18*			18*			
t_s	Settling time	A_{VD} = –1, 2-V step, R_L = 1 kΩ, C_L = 100 pF	To 10 mV	25°C		0.25			0.25		μs
			To 1 mV			0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω, See Figure 3	f = 10 Hz	25°C		28	55*		28	55*	nV/√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		μV
			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/√Hz
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 5 V, f = 1 kHz, R_S = 25 Ω	A_{VD} = 10, R_L = 2 kΩ,	25°C		0.013%			0.013%		
B_1	Unity-gain bandwidth	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C		9.4			9.4		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 4 V, R_L = 2 kΩ,	A_{VD} = –1, C_L = 25 pF	25°C		2.8			2.8		MHz
ϕ_m	Phase margin at unity gain	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, 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°C to 125°C.

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

PARAMETER			TEST CONDITIONS		T_A†	TLE2074M			TLE2074AM			UNIT
						MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage		V_{IC} = 0, V_O = 0, R_S = 50 Ω		25°C		–1.6	5		–0.5	3	mV
					Full range			10.5			8.5	
α_{VIO}	Temperature coefficient of input offset voltage				Full range		10.1	30*		10.1	30*	µV/°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			65			65	nA
V_{ICR}	Common-mode input voltage range		R_S = 50 Ω		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 µA		25°C	13.8	14.1		13.8	14.1		V
					Full range	13.6			13.6			
			I_O = –2 mA		25°C	13.5	13.9		13.5	13.9		
					Full range	13.3			13.3			
			I_O = –20 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 µA		25°C	–13.8	–14.2		–13.8	–14.2		V
					Full range	–13.6			–13.6			
			I_O = 2 mA		25°C	–13.5	–14		–13.5	–14		
					Full range	–13.3			–13.3			
			I_O = 20 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 = ± 10 V	R_L = 600 Ω	25°C	80	96		80	96		dB
					Full range	78			78			
				R_L = 2 kΩ	25°C	90	109		90	109		
					Full range	88			88			
				R_L = 10 kΩ	25°C	95	118		95	118		
					Full range	93			93			
r_i	Input resistance		V_{IC} = 0		25°C		10^{12}			10^{12}		Ω
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		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		25°C	80	98		80	98		dB
					Full range	78			78			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		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.

electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±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 kΩ	25°C		120			120		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	–30	–45		–30	–45		mA
			V_{ID} = –1 V		30	48		30	48		

† Full range is –55°C to 125°C.

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

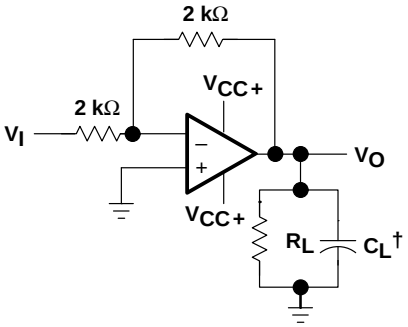
PARAMETER		TEST CONDITIONS		T_A†	TLE2074M			TLE2074AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	$V_{O(PP)}$ = 10 V, R_L = 2 kΩ, See Figure 1	A_{VD} = –1, C_L = 100 pF,	25°C	25	40		25	40		V/μs
				Full range	17			17			
SR–	Negative slew rate			25°C	30	45		30	45		V/μs
				Full range	20			20			
t_s	Settling time	A_{VD} = –1, 10-V step, R_L = 1 kΩ, C_L = 100 pF	To 10 mV	25°C		0.4			0.4		μs
			To 1 mV			1.5			1.5		
V_n	Equivalent input noise voltage	R_S = 20 Ω, See Figure 3	f = 10 Hz	25°C		28	55*		28	55*	nV/√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		μV
			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/√Hz
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, f = 1 kHz, R_S = 25 Ω	A_{VD} = 10, R_L = 2 kΩ,	25°C		0.008%			0.008%		
B_1	Unity-gain bandwidth	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, See Figure 2	25°C	8*	10		8*	10		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, R_L = 2 kΩ,	A_{VD} = –1, C_L = 25 pF	25°C	478*	637		478*	637		kHz
ϕ_m	Phase margin at unity gain	V_I = 10 mV, C_L = 25 pF,	R_L = 2 kΩ, 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°C to 125°C.

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

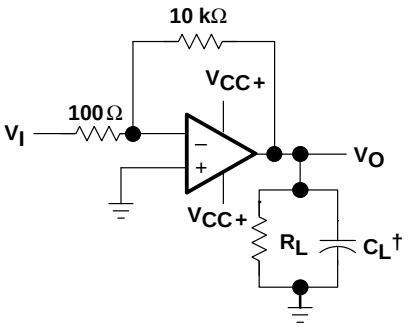
PARAMETER			TEST CONDITIONS		TLE2074Y MIN	TLE2074Y TYP	TLE2074Y MAX	UNIT
V_{IO}	Input offset voltage		V_{IC} = 0, V_O = 0, R_S = 50 Ω				5	mV
I_{IO}	Input offset current		V_{IC} = 0, V_O = 0, See Figure 4			15	100	pA
I_{IB}	Input bias current					25	175	pA
V_{ICR}	Common-mode input voltage range		R_S = 50 Ω		15 to −11	15 to 11.9		V
V_{OM+}	Maximum positive peak output voltage swing		I_O = −200 μA		13.8	14.1		V
			I_O = −2 mA		13.5	13.9		
			I_O = −20 mA		11.5	12.3		
V_{OM-}	Maximum negative peak output voltage swing		I_O = 200 μA		−13.8	−14.2		V
			I_O = 2 mA		−13.5	−14		
			I_O = 20 mA		−11.5	−12.4		
A_{VD}	Large-signal differential voltage amplification		V_O = ± 10 V	R_L = 600 Ω	80	96		dB
				R_L = 2 kΩ	90	109		
				R_L = 10 kΩ	95	118		
r_i	Input resistance		V_{IC} = 0			10^{12}		Ω
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 MHz			80		Ω
CMRR	Common-mode rejection ratio		V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω		80	98		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)		$V_{CC\pm}$ = ±5 V to ±15 V, V_O = 0, R_S = 50 Ω		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 V	−30	−45		mA
				V_{ID} = −1 V	30	48		

PARAMETER MEASUREMENT INFORMATION



† Includes fixture capacitance

Figure 3. Slew-Rate Test Circuit



† Includes fixture capacitance

Figure 4. Unity-Gain Bandwidth and Phase-Margin Test Circuit

PARAMETER MEASUREMENT INFORMATION

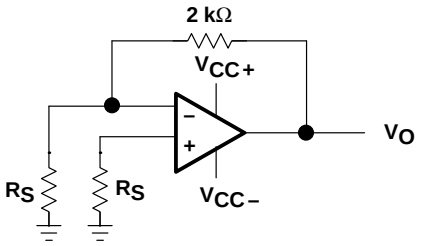


Figure 5. Noise-Voltage Test Circuit

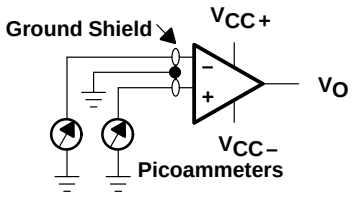


Figure 6. Input-Bias and Offset-Current Test Circuit

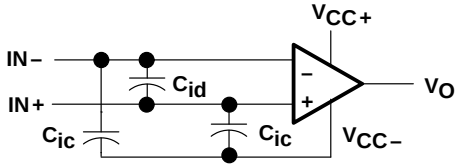


Figure 7. Internal Input Capacitance

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 TLE2074 and TLE2074A, 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.

TYPICAL CHARACTERISTICS

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V_O	Output voltage	vs Differential input voltage	14, 15
V_{OM+}	Maximum positive peak output voltage	vs Output current vs Free-air temperature vs Supply voltage	16 18, 19 20
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$V_{O(PP)}$	Maximum peak-to-peak output voltage	vs Frequency	21
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CMRR	Common-mode rejection ratio	vs Frequency vs Free-air temperature	28 29
k_{SVR}	Supply-voltage rejection ratio	vs Frequency vs Free-air temperature	30 31
I_{CC}	Supply current	vs Supply voltage vs Free-air temperature vs Differential input voltage	32 33 34, 35
I_{OS}	Short-circuit output current	vs Supply voltage vs Time vs Free-air temperature	36 37 38
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TYPICAL CHARACTERISTICS†

DISTRIBUTION OF TLE2074 INPUT OFFSET VOLTAGE

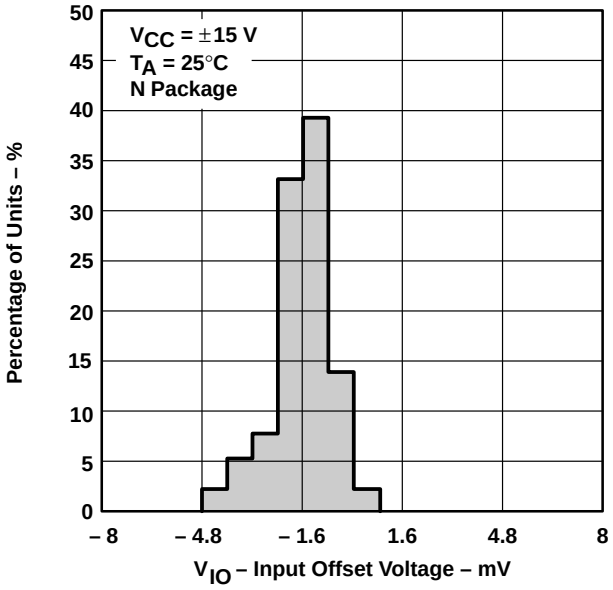


Figure 8

DISTRIBUTION OF TLE2074 INPUT OFFSET VOLTAGE TEMPERATURE COEFFICIENT

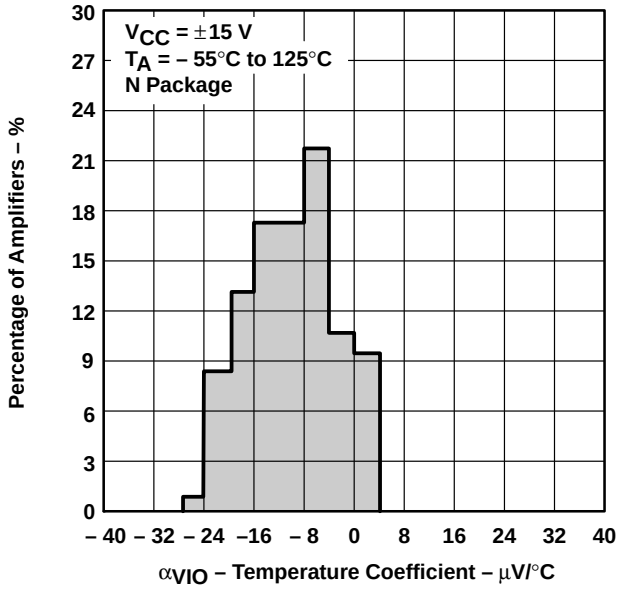


Figure 9

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

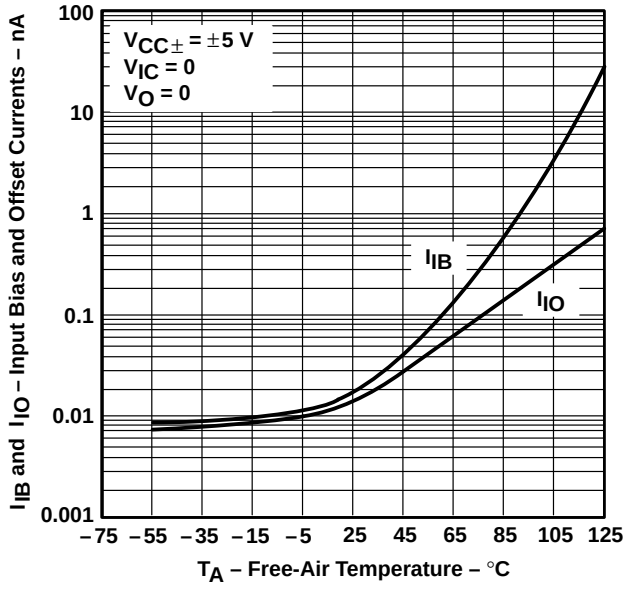


Figure 10

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

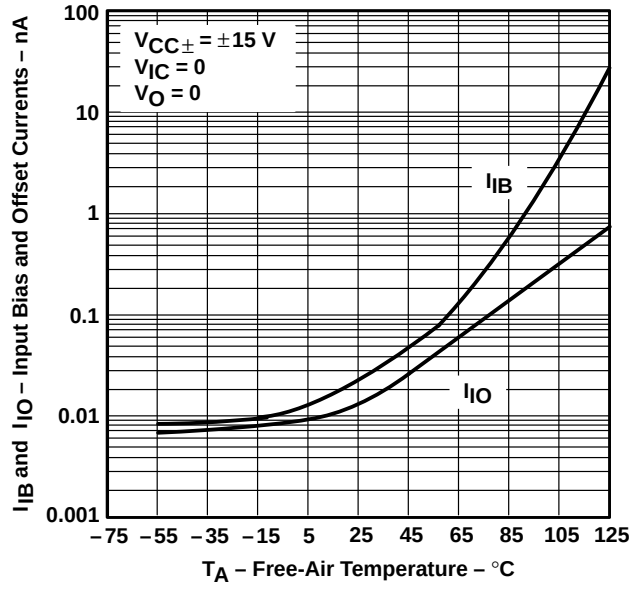


Figure 11

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

TYPICAL CHARACTERISTICS†

INPUT BIAS CURRENT vs TOTAL SUPPLY VOLTAGE

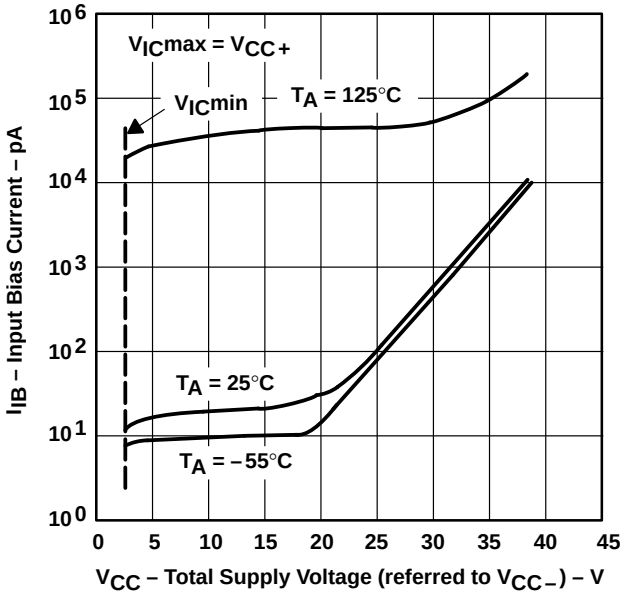


Figure 12

COMMON-MODE INPUT VOLTAGE RANGE vs FREE-AIR TEMPERATURE

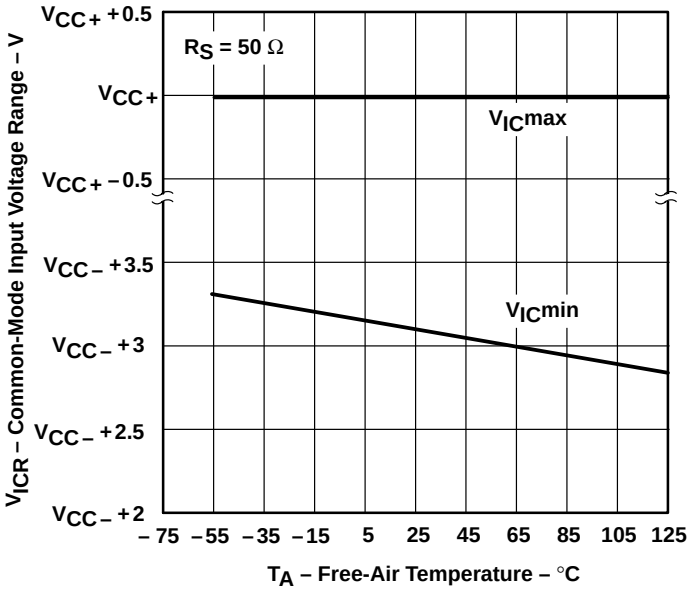


Figure 13

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

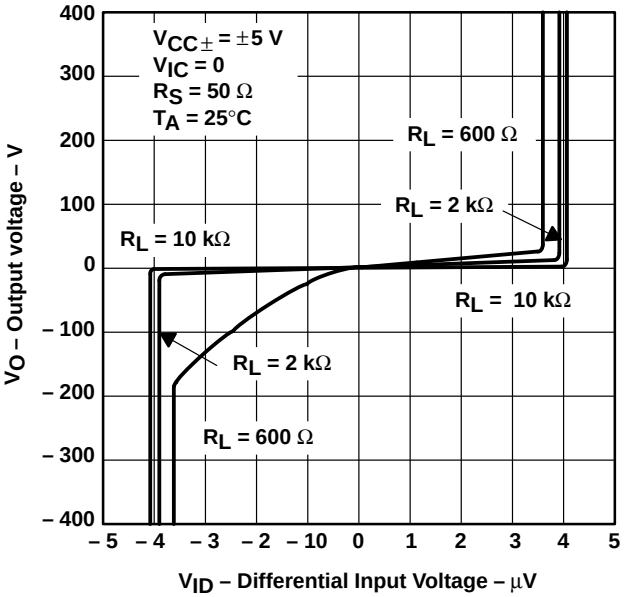


Figure 14

OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE

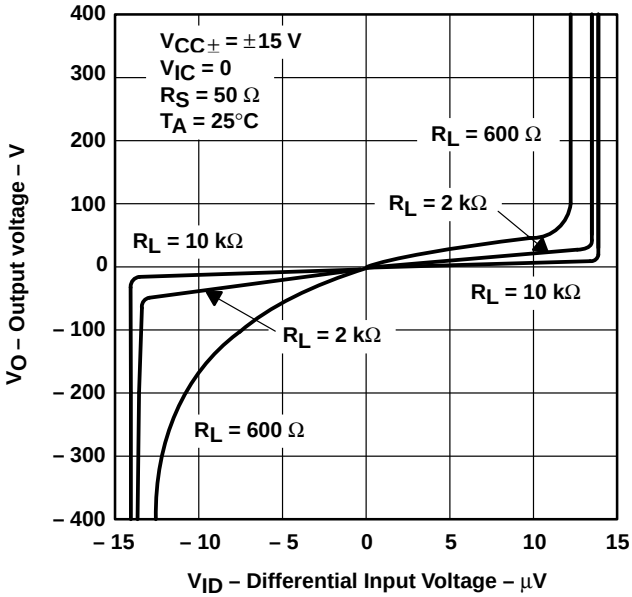


Figure 15

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

TYPICAL CHARACTERISTICS†

MAXIMUM POSITIVE PEAK OUTPUT VOLTAGE
vs
OUTPUT CURRENT

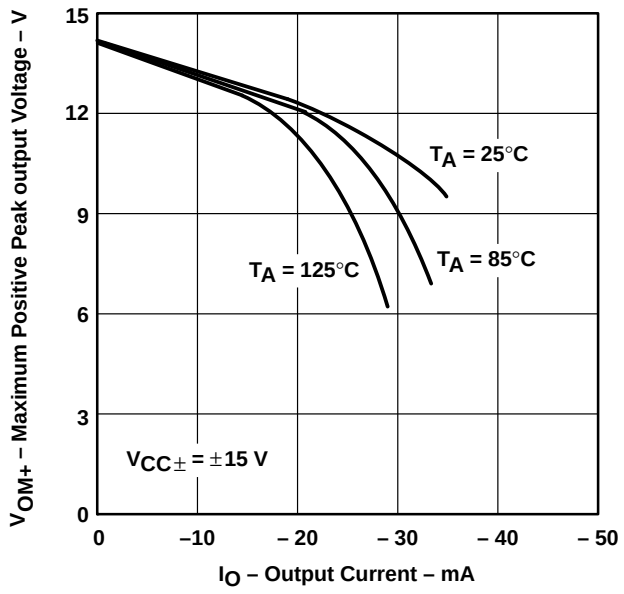


Figure 16

MAXIMUM NEGATIVE PEAK OUTPUT VOLTAGE
vs
OUTPUT CURRENT

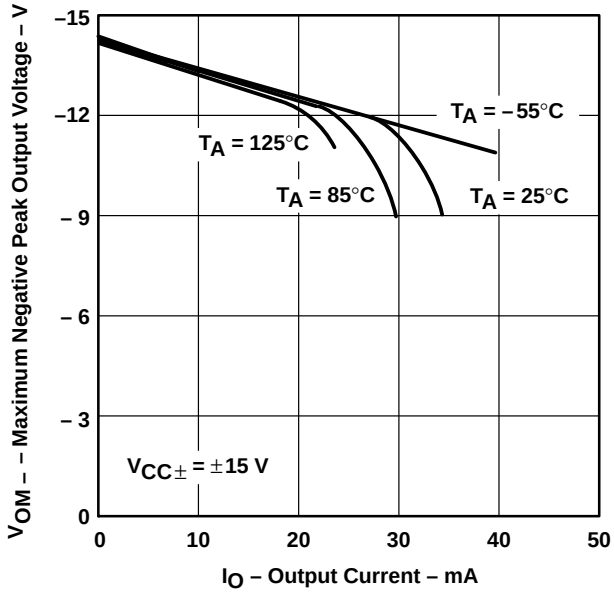


Figure 17

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

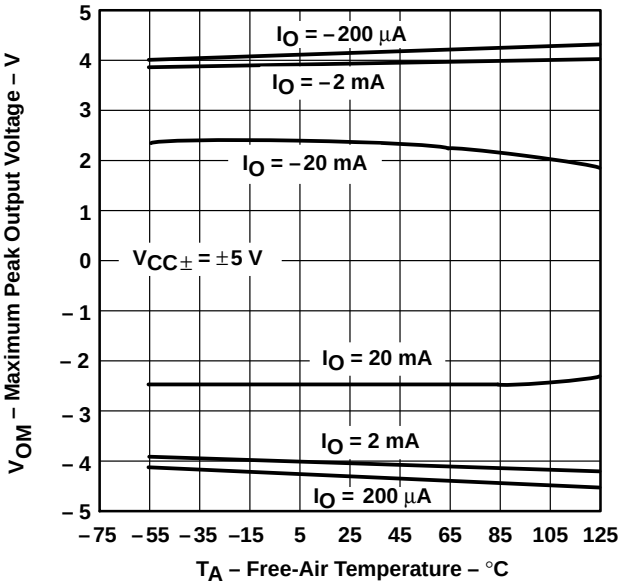


Figure 18

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

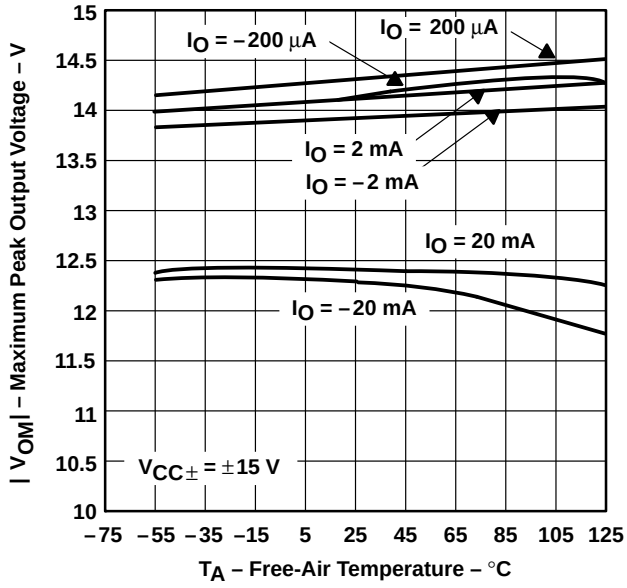


Figure 19

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

TYPICAL CHARACTERISTICS†

MAXIMUM PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE

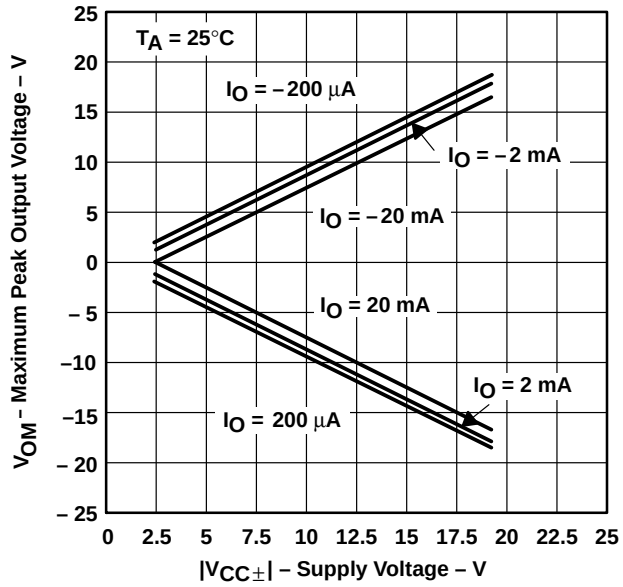


Figure 20

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE vs FREQUENCY

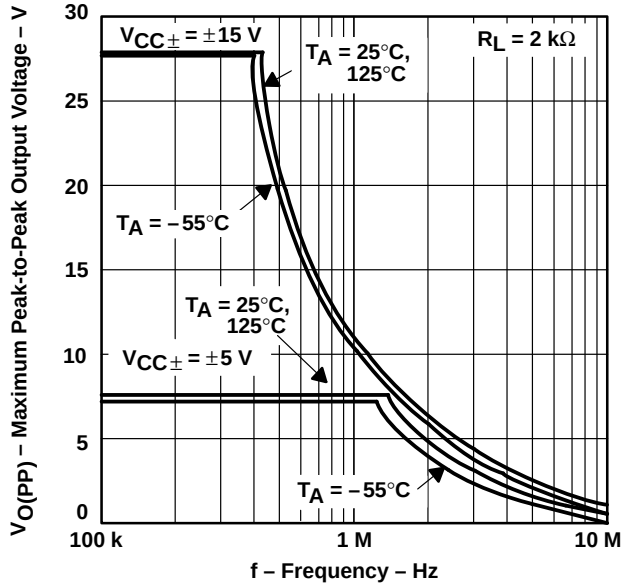


Figure 21

OUTPUT VOLTAGE vs SETTLING TIME

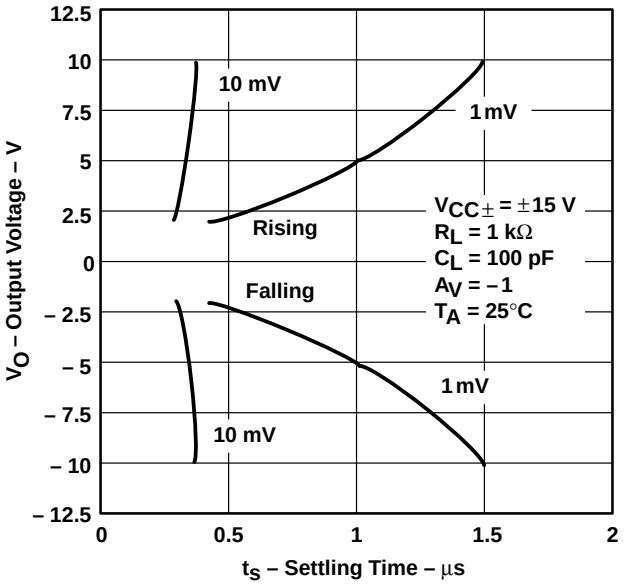


Figure 22

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs LOAD RESISTANCE

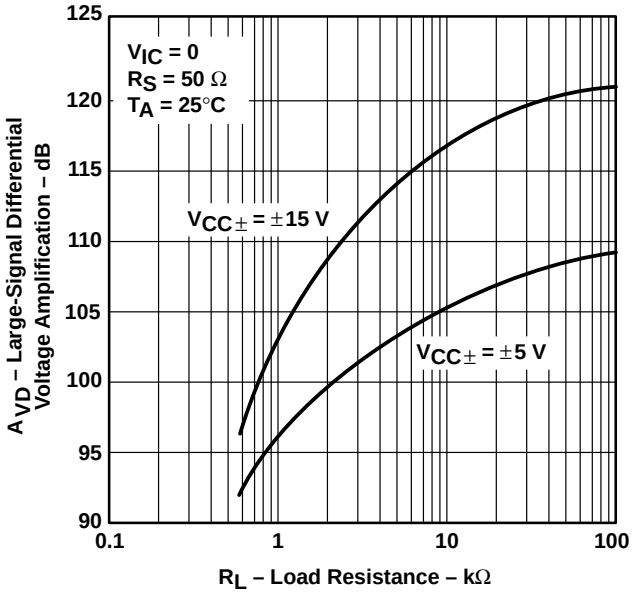


Figure 23

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

TYPICAL CHARACTERISTICS†

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

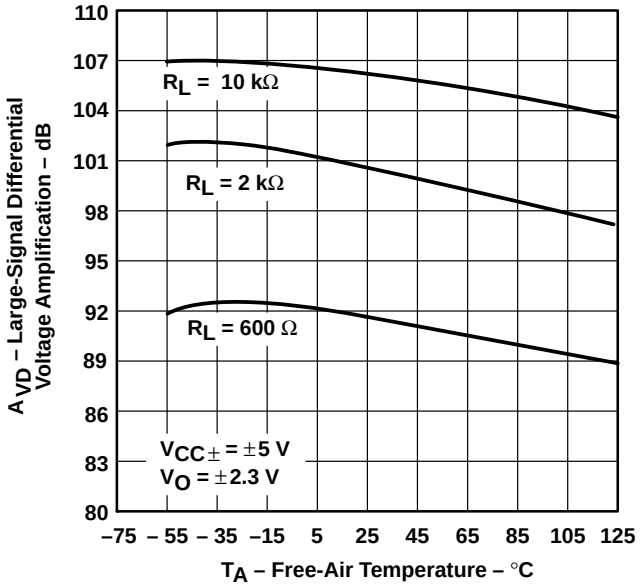


Figure 24

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

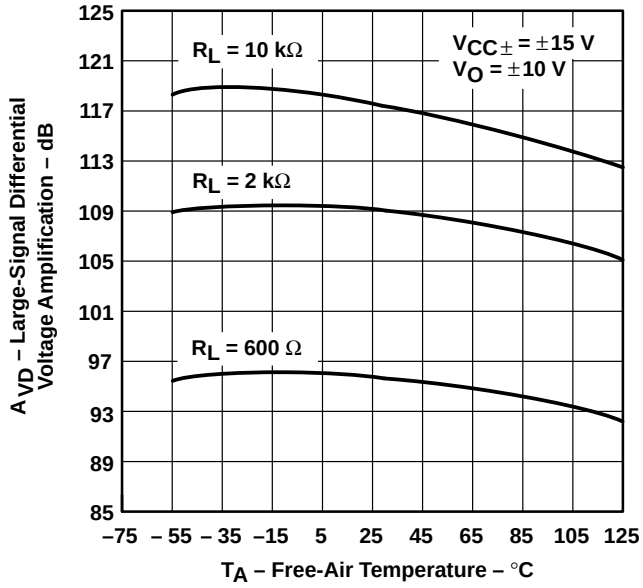


Figure 25

† 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

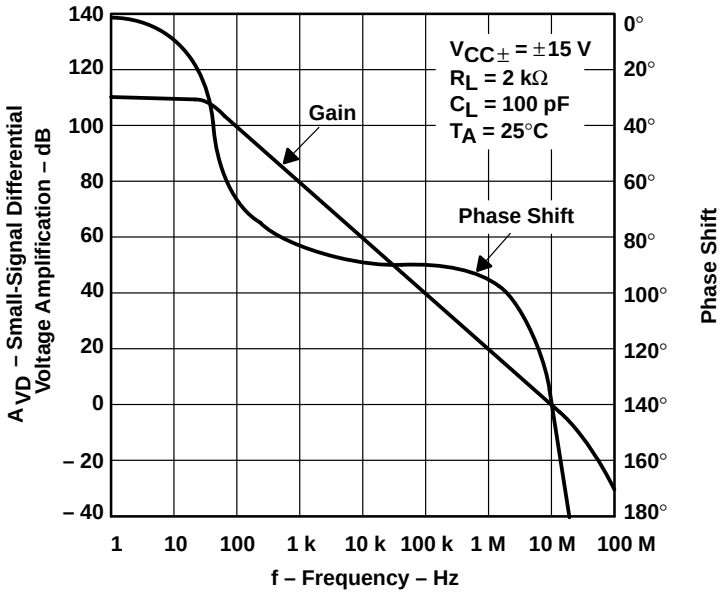


Figure 26

SMALL-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT vs FREQUENCY

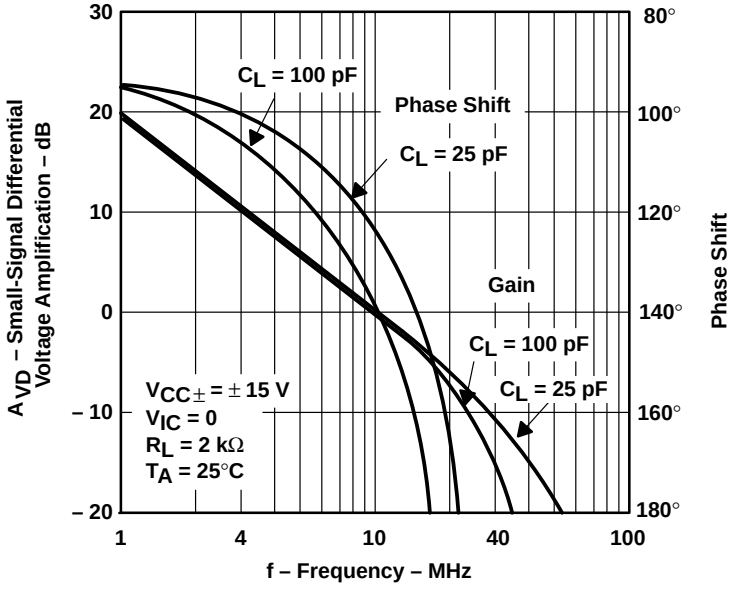


Figure 27

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

TYPICAL CHARACTERISTICS†

COMMON-MODE REJECTION RATIO vs FREQUENCY

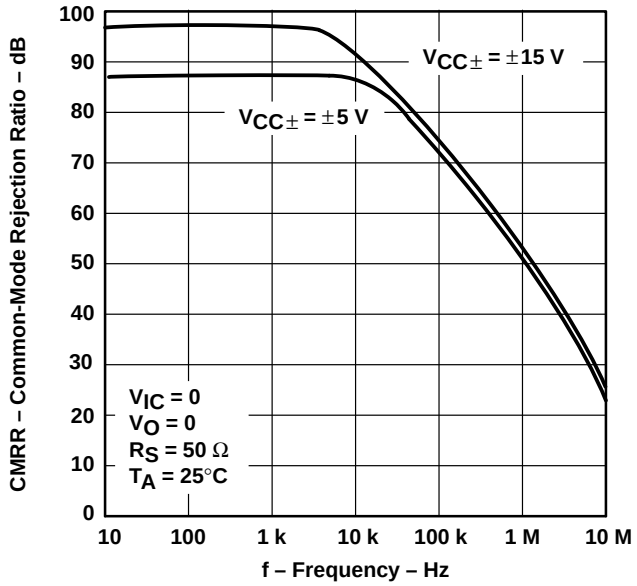


Figure 28

COMMON-MODE REJECTION RATIO vs FREE-AIR TEMPERATURE

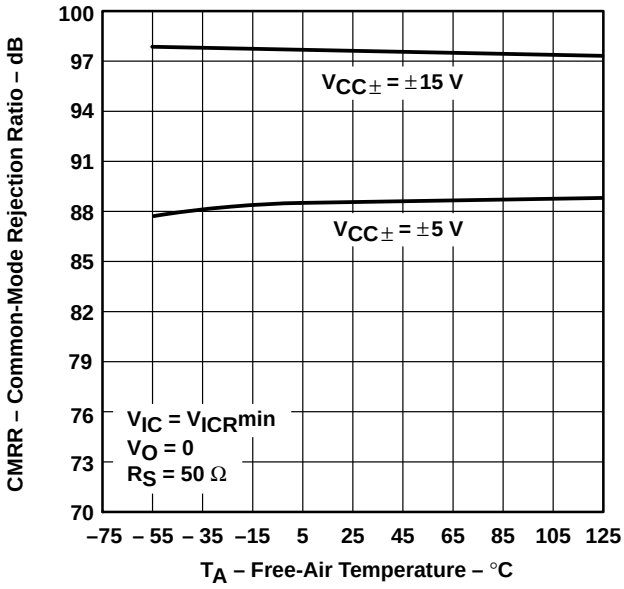


Figure 29

SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY

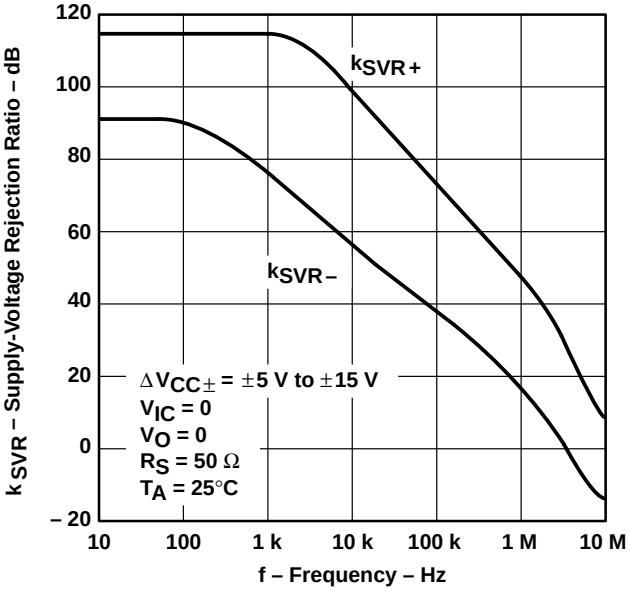


Figure 30

SUPPLY-VOLTAGE REJECTION RATIO vs FREE-AIR TEMPERATURE

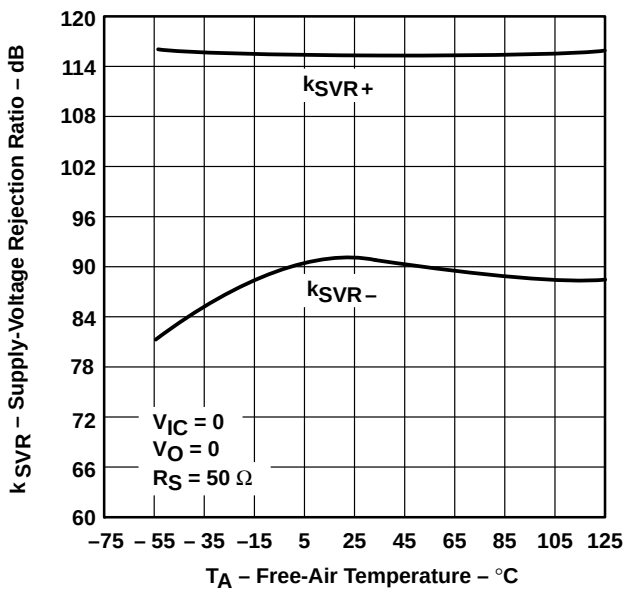


Figure 31

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

TYPICAL CHARACTERISTICS†

SUPPLY CURRENT vs SUPPLY VOLTAGE

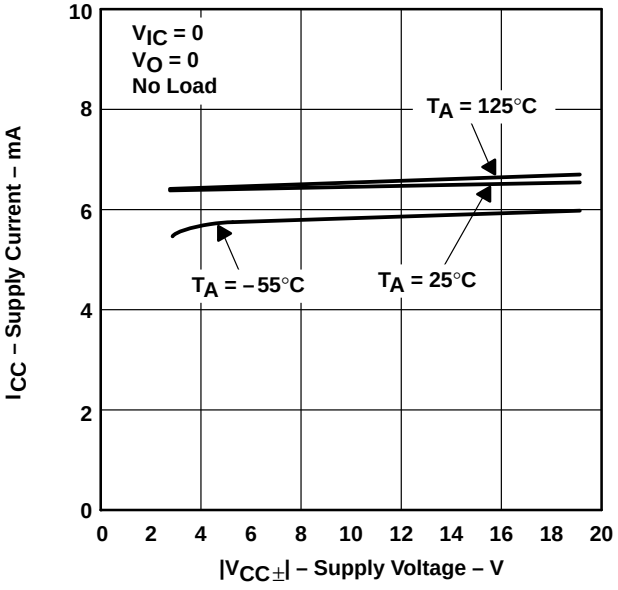


Figure 32

SUPPLY CURRENT vs FREE-AIR TEMPERATURE

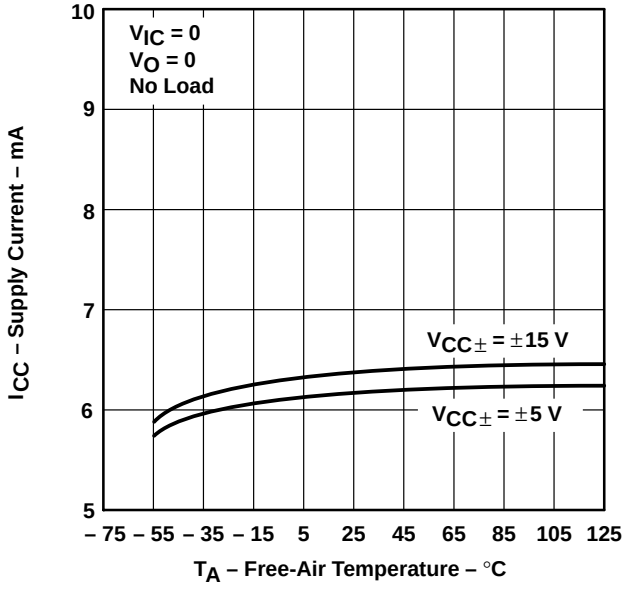


Figure 33

SUPPLY CURRENT vs DIFFERENTIAL INPUT VOLTAGE

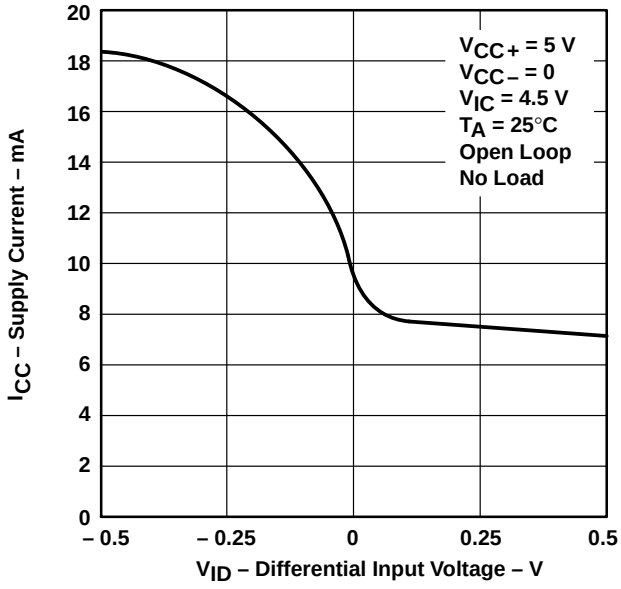


Figure 34

SUPPLY CURRENT vs DIFFERENTIAL INPUT VOLTAGE

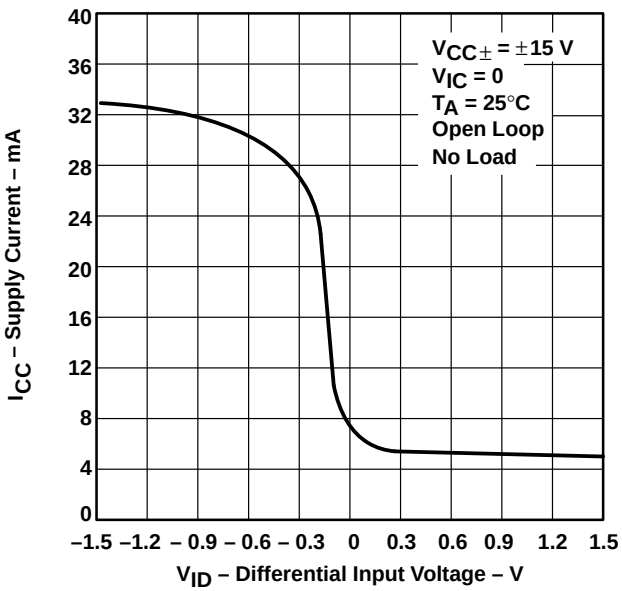


Figure 35

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

TYPICAL CHARACTERISTICS†

SHORT-CIRCUIT OUTPUT CURRENT vs SUPPLY VOLTAGE

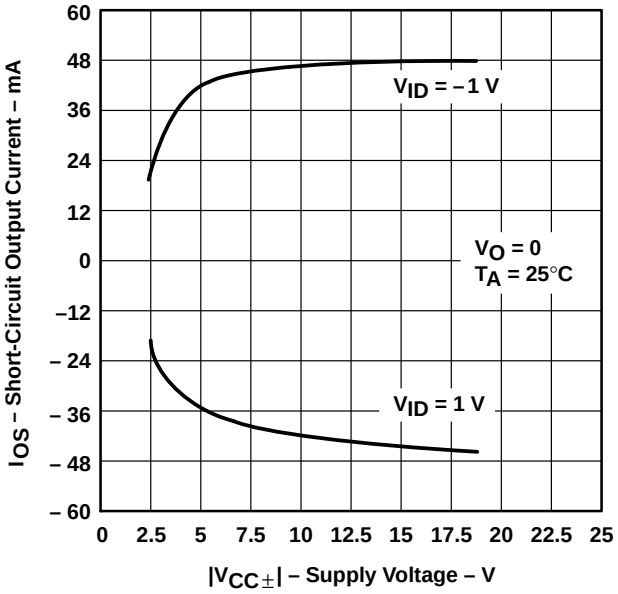


Figure 36

SHORT-CIRCUIT OUTPUT CURRENT vs ELAPSED TIME

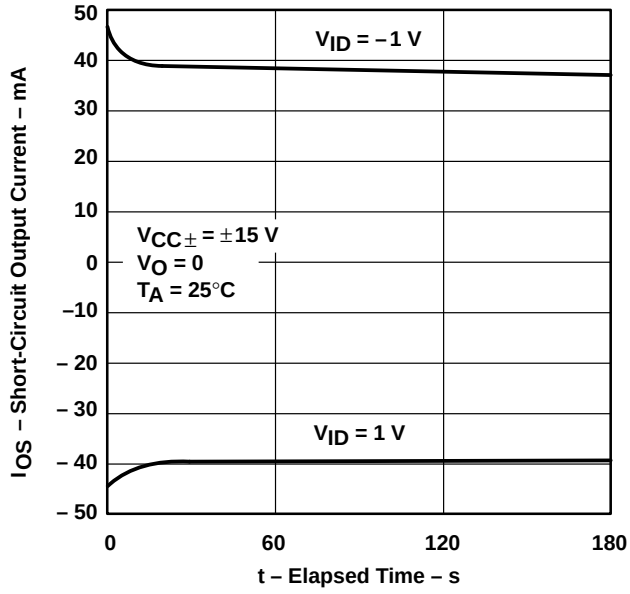


Figure 37

SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE

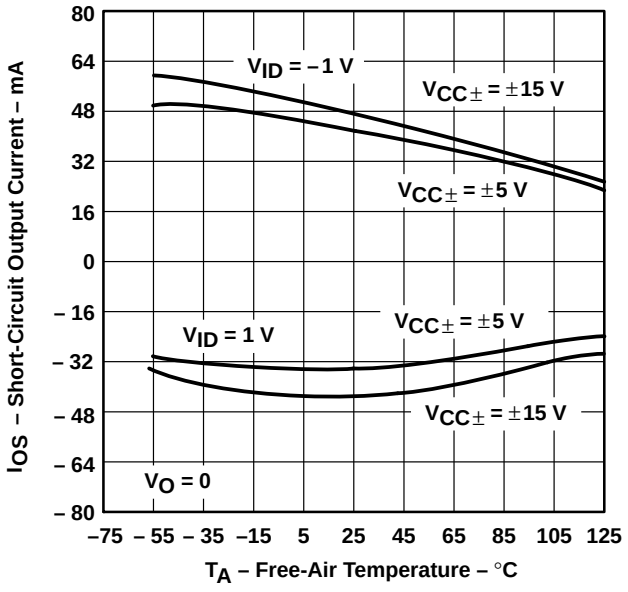


Figure 38

SLEW RATE vs FREE-AIR TEMPERATURE

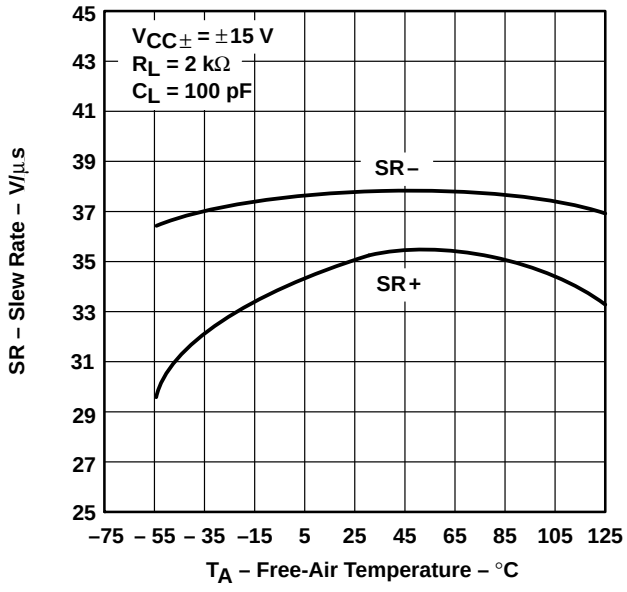


Figure 39

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

TYPICAL CHARACTERISTICS†

SLEW RATE vs FREE-AIR TEMPERATURE

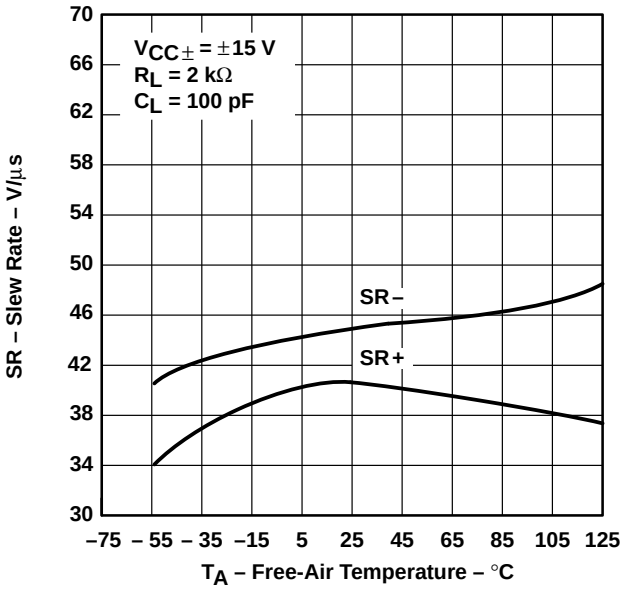


Figure 40

SLEW RATE vs LOAD RESISTANCE

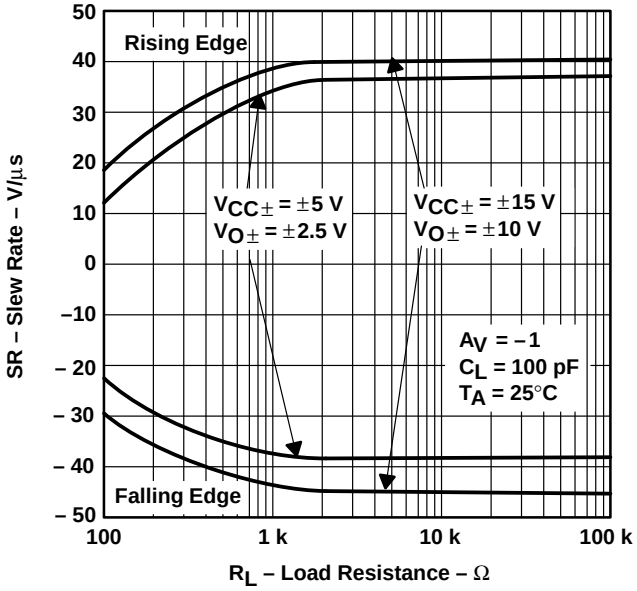


Figure 41

SLEW RATE vs DIFFERENTIAL INPUT VOLTAGE

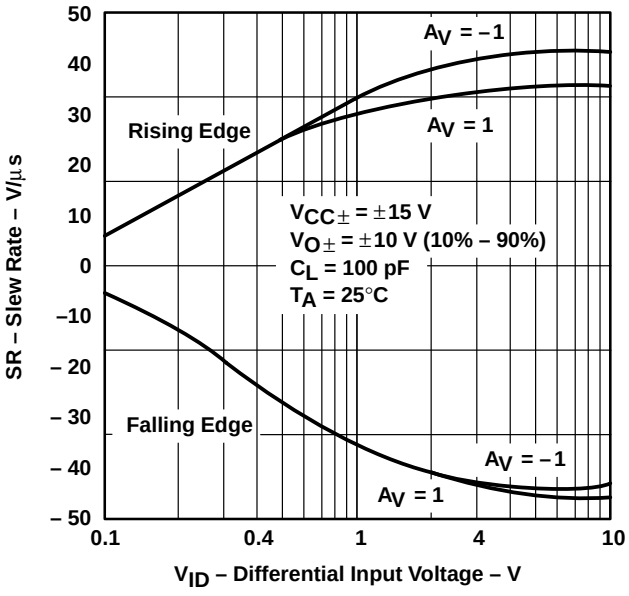


Figure 42

EQUIVALENT INPUT NOISE VOLTAGE (SPECTRAL DENSITY) vs FREQUENCY

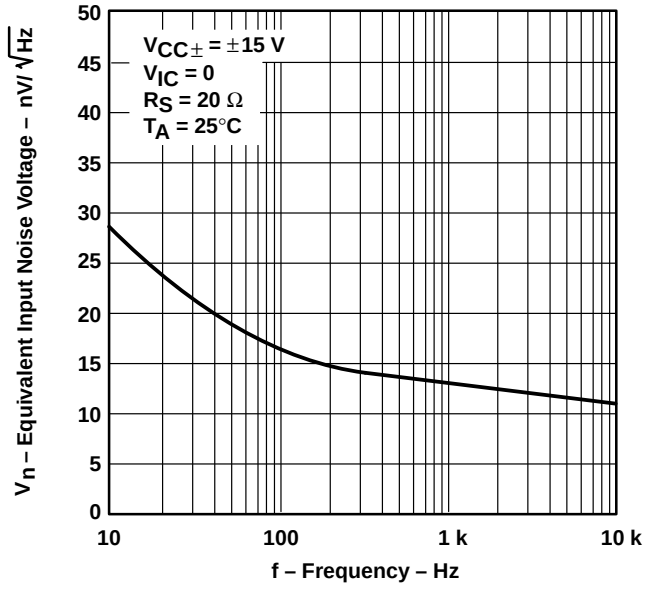


Figure 43

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

TYPICAL CHARACTERISTICS

INPUT-REFERRED NOISE VOLTAGE vs NOISE BANDWIDTH

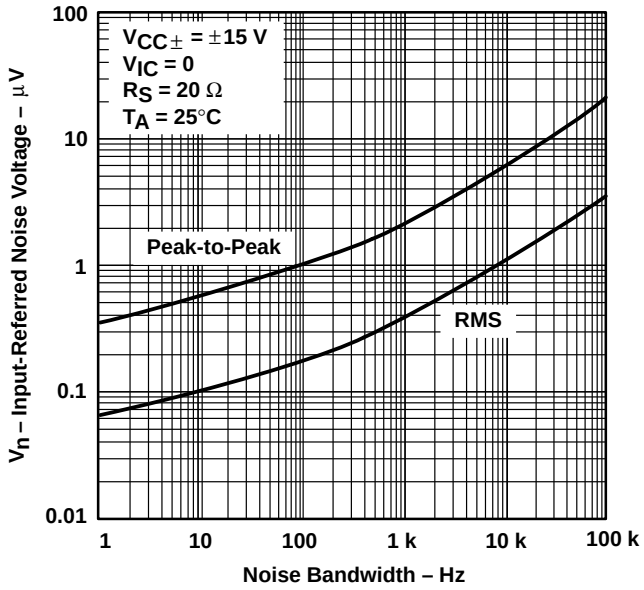


Figure 44

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

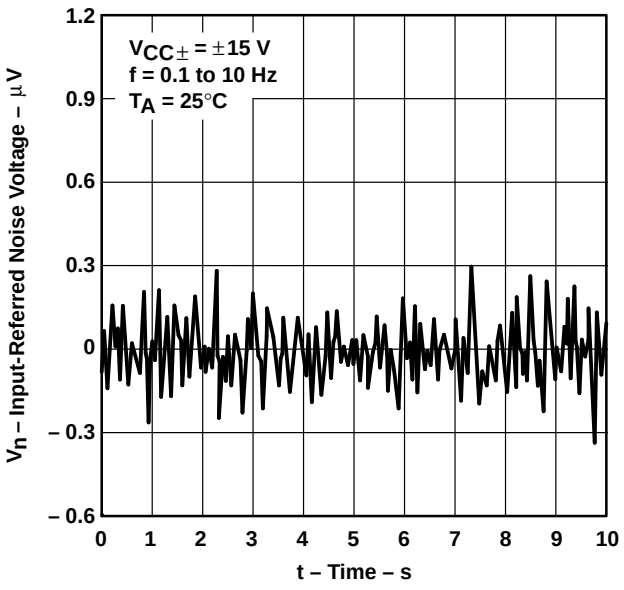


Figure 45

THIRD-OCTAVE SPECTRAL NOISE DENSITY vs FREQUENCY

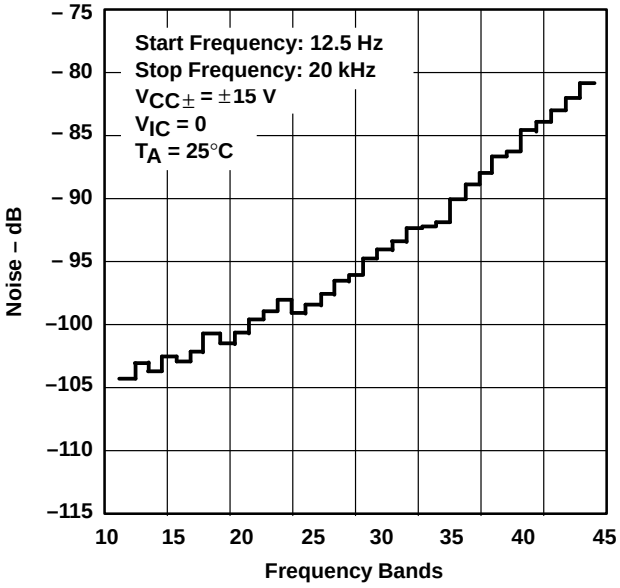


Figure 46

TOTAL HARMONIC DISTORTION PLUS NOISE vs FREQUENCY

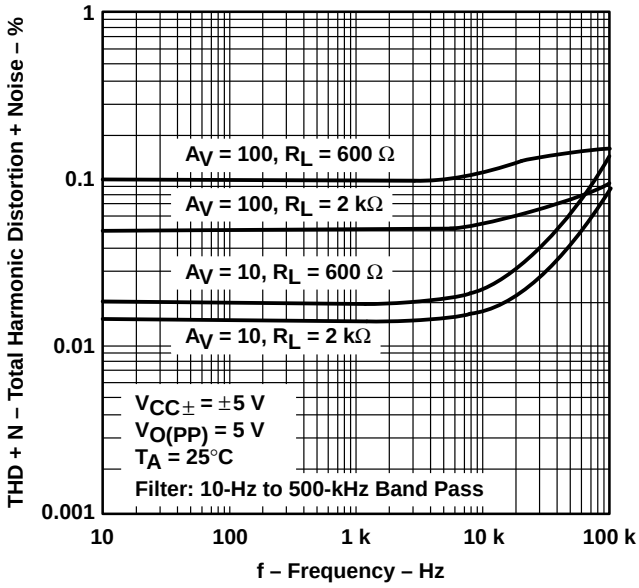


Figure 47

TYPICAL CHARACTERISTICS†

TOTAL HARMONIC DISTORTION PLUS NOISE vs FREQUENCY

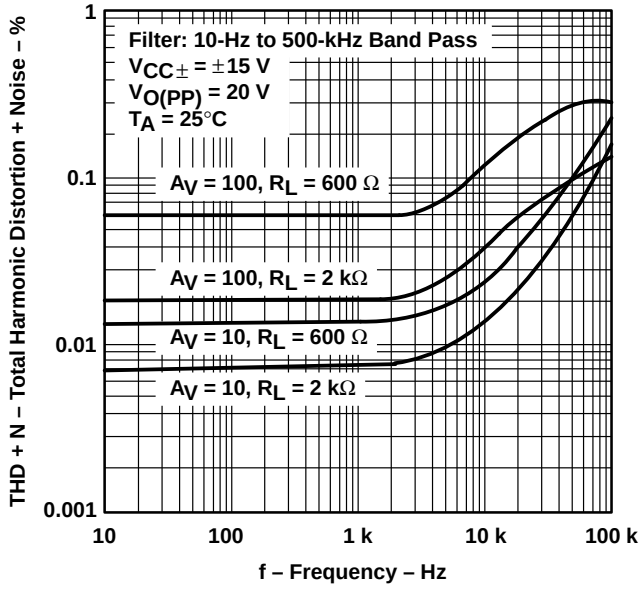


Figure 48

UNITY-GAIN BANDWIDTH vs LOAD CAPACITANCE

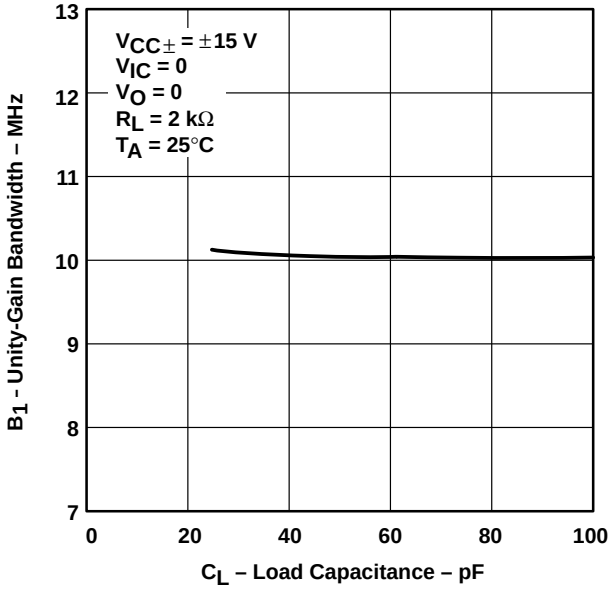


Figure 49

GAIN-BANDWIDTH PRODUCT vs FREE-AIR TEMPERATURE

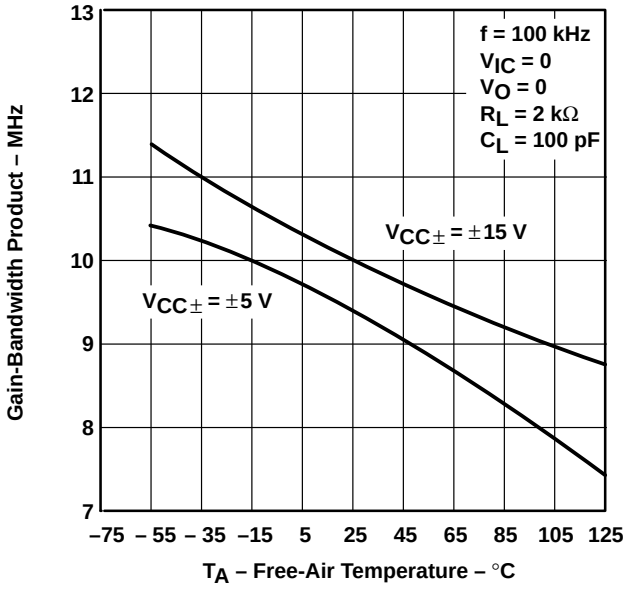


Figure 50

GAIN-BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

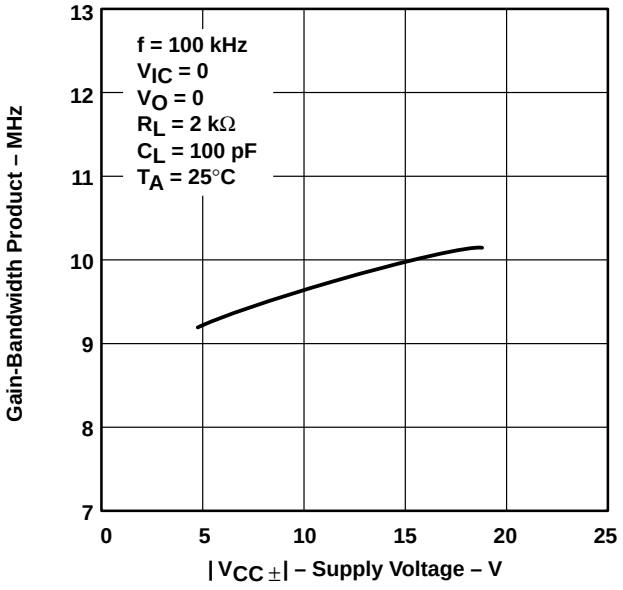


Figure 51

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

TYPICAL CHARACTERISTICS†

GAIN MARGIN vs LOAD CAPACITANCE

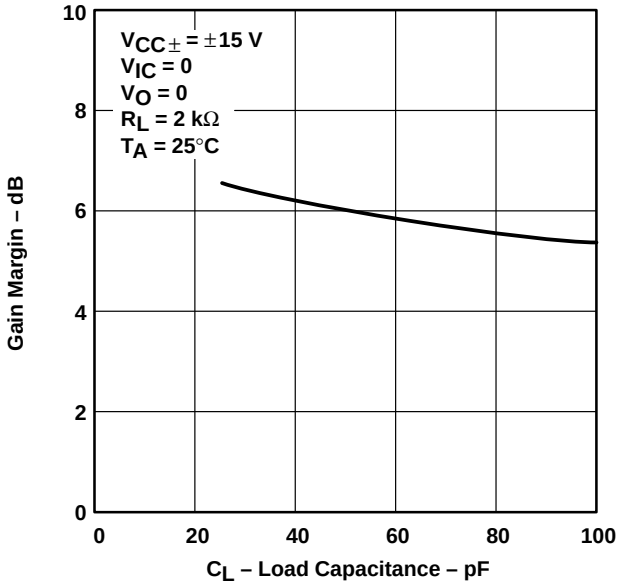


Figure 52

PHASE MARGIN vs TEMPERATURE

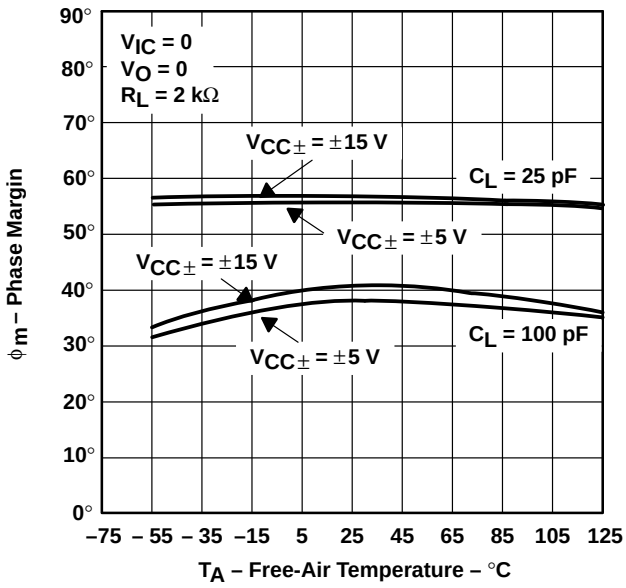


Figure 53

PHASE MARGIN vs SUPPLY VOLTAGE

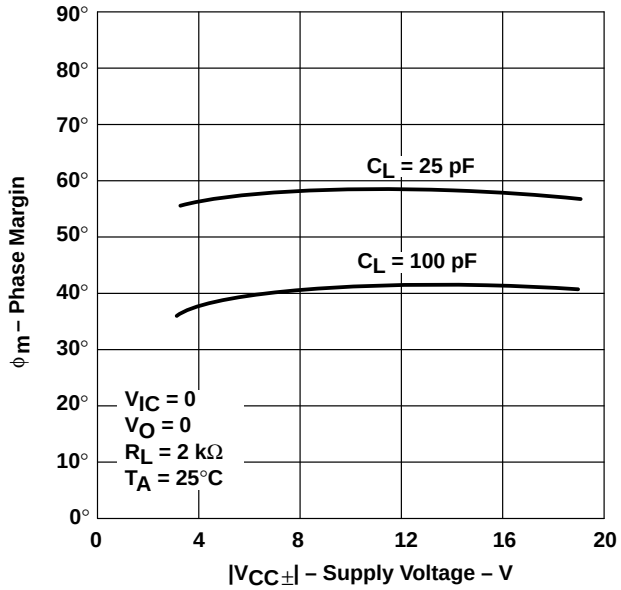


Figure 54

PHASE MARGIN vs LOAD CAPACITANCE

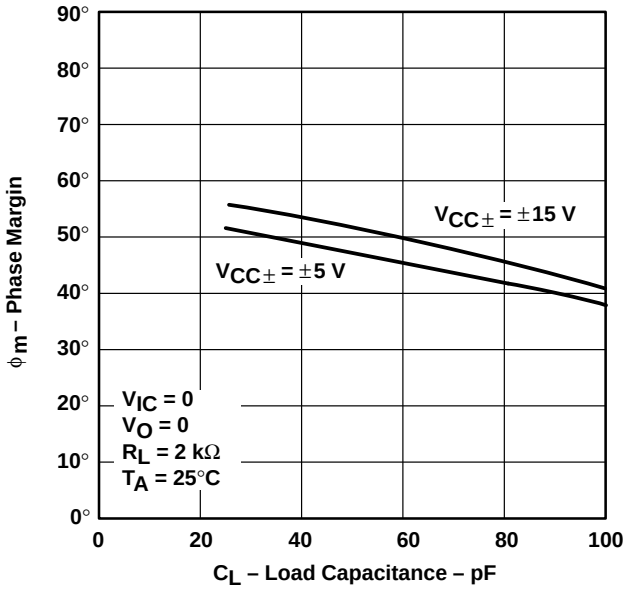


Figure 55

† 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

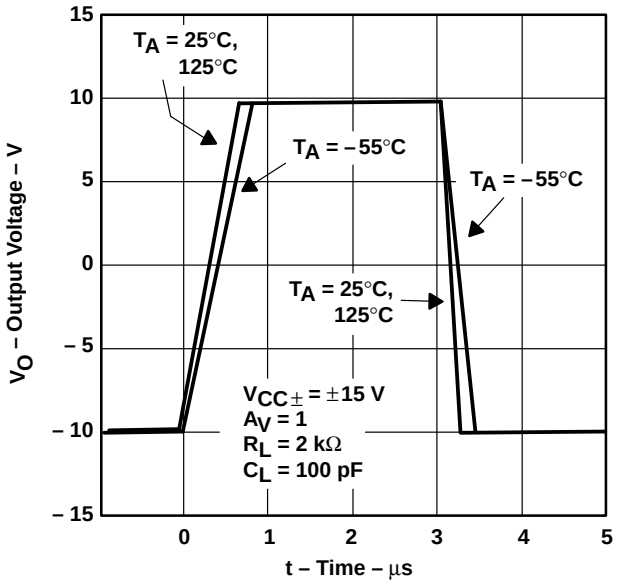


Figure 56

SMALL-SIGNAL PULSE RESPONSE

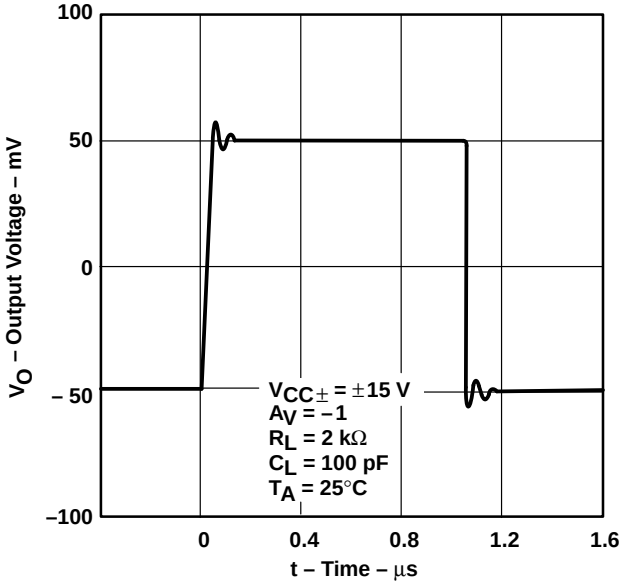


Figure 57

CLOSED-LOOP OUTPUT IMPEDANCE vs FREQUENCY

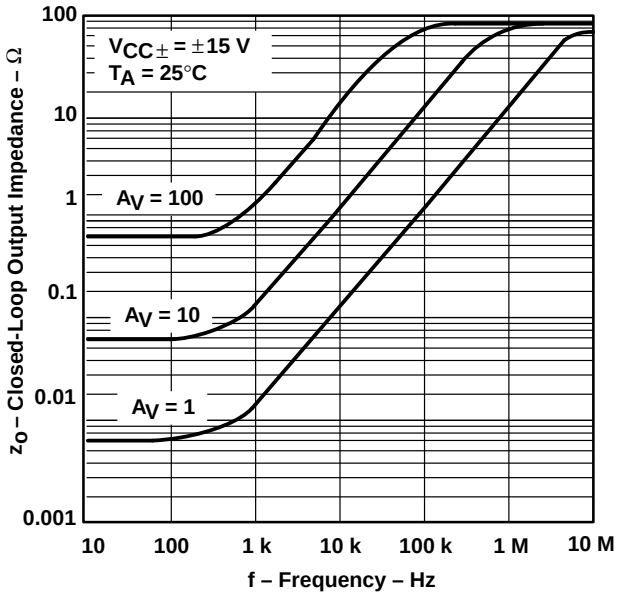


Figure 58

CROSSTALK ATTENUATION vs FREQUENCY

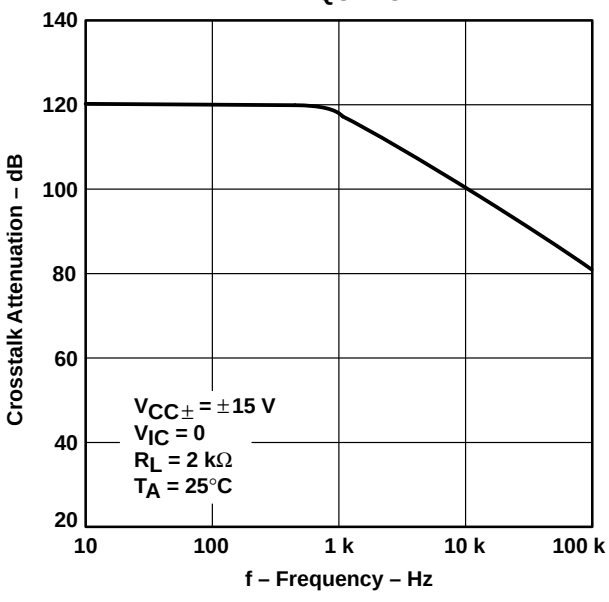


Figure 59

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

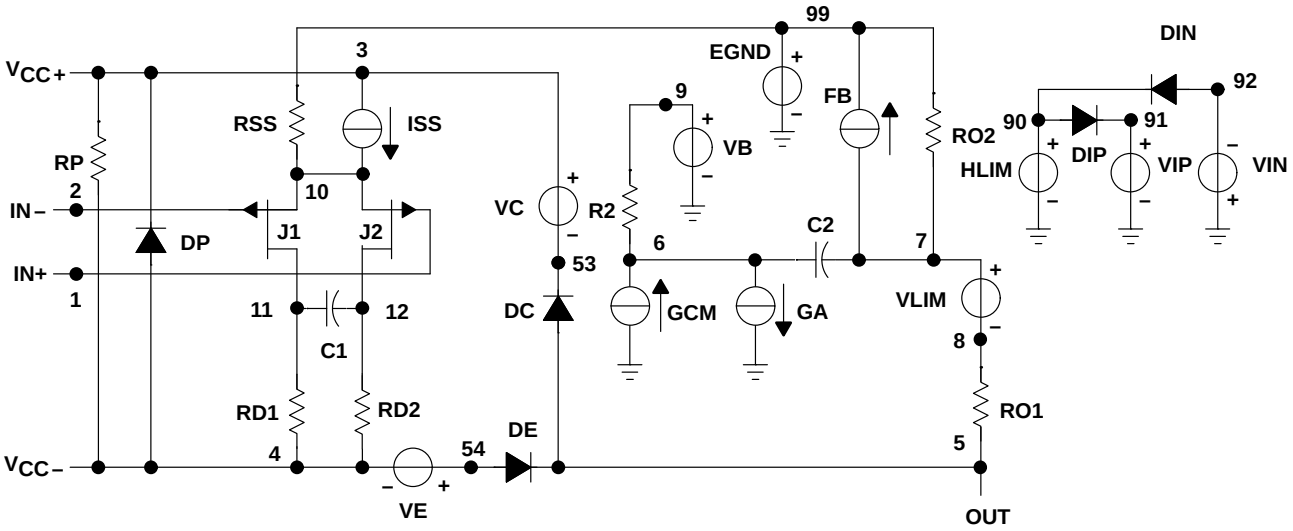
APPLICATION INFORMATION

macromodel information

Macromodel information provided was derived using *PSpice*™ *Parts*™ model generation software. The Boyle macromodel (see Note 4) and subcircuit in Figure 60 were generated using the TLE2074 typical electrical and operating characteristics at $T_A = 25°C$. Using this information, output simulations of the following key parameters can be generated to a tolerance of 20% (in most cases):

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

NOTE 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).




```
.SUBCKT TLE2074 1 2 3 4 5
C1      11      12      2.2E–12
C2      6       7       10.00E–12
DC      5       53      DX
DE      54      5       DX
DLP     90      91      DX
DLN     92      90      DX
DP      4       3       DX
EGND    99      0       POLY (2) (3,0) (4,0) 0 .5 .5
FB      7       99      POLY (5) VB VC VE VLP VLN 0
+ 5.607E6 –6E6 6E6 6E6 –6E6
GA      6       0       11 12 333.0E–6
GCM     0       6       10 99 7.43E–9
ISS     3       10      DC 400.0E–6
HLIM    90      0       VLIM 1K
J1      11      2       10 JX
J2      12      1       10 JX
R2      6       9       100.0E3
RD1     4       11      3.003E3
RD2     4       12      3.003E3
R01     8       5       80
R02     7       99      80
RP      3       4       27.30E3
RSS     10      99      500.0E3
VB      9       0       DC 0
VC      3       53      DC 2.20
VE      54      4       DC 2.20
VLIM    7       8       DC 0
VLP     91      0       DC 45
VLN     0       92      DC 45
.MODEL DX D (IS=800.0E–18)
.MODEL JX PJF (IS=15.00E–12 BETA=554.5E–6
+ VTO=–.6)
.ENDS
```

Figure 60. Boyle Macromodel and Subcircut

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