TLE214x, TLE214xA, TLE214xY EXCALIBUR LOW-NOISE HIGH-SPEED PRECISION OPERATIONAL AMPLIFIERS

SLOS183A – FEBRUARY 1997 – REVISED MARCH 1998

- **Low Noise**
  - **10 Hz . . . 15 nV/√Hz**
  - **1 kHz . . . 10.5 nV/√Hz**
- **10 000-pF Load Capability**
- **20-mA Min Short-Circuit Output Current**
- **27-V/μs Min Slew Rate**
- **High Gain-Bandwidth Product . . . 5.9 MHz**
- **Low V_{IO} . . . 500 μV Max at 25°C**
- **Single or Split Supply . . . 4 V to 44 V**
- **Fast Settling Time**
  - **340 ns to 0.1%**
  - **400 ns to 0.01%**
- **Saturation Recovery . . . 150 ns**
- **Large Output Swing**
  - **V_{CC-} +0.1 V to V_{CC+} – 1 V**

description

The TLE214x and TLE214xA devices are high-performance, internally compensated operational amplifiers built using Texas Instruments complementary bipolar Excalibur process. The TLE214xA is a tighter offset voltage grade of the TLE214x. Both are pin-compatible upgrades to standard industry products.

The design incorporates an input stage that simultaneously achieves low audio-band noise of 10.5 nV/√Hz with a 10-Hz 1/f corner and symmetrical 40-V/μs slew rate typically with loads up to 800 pF. The resulting low distortion and high power bandwidth are important in high-fidelity audio applications. A fast settling time of 340 ns to 0.1% of a 10-V step with a 2-kΩ/100-pF load is useful in fast actuator/positioning drivers. Under similar test conditions, settling time to 0.01% is 400 ns.

The devices are stable with capacitive loads up to 10 nF, although the 6-MHz bandwidth decreases to 1.8 MHz at this high loading level. As such, the TLE214x and TLE214xA are useful for low-droop sample-and-holds and direct buffering of long cables, including 4-mA to 20-mA current loops.

The special design also exhibits an improved insensitivity to inherent integrated circuit component mismatches as is evidenced by a 500-μV maximum offset voltage and 1.7-μV/°C typical drift. Minimum common-mode rejection ratio and supply-voltage rejection ratio are 85 dB and 90 dB, respectively.

Device performance is relatively independent of supply voltage over the ±2-V to ±22-V range. Inputs can operate between $V_{CC-} - 0.3$ to $V_{CC+} - 1.8$ V without inducing phase reversal, although excessive input current may flow out of each input exceeding the lower common-mode input range. The all-npn output stage provides a nearly rail-to-rail output swing of $V_{CC-} - 0.1$ to $V_{CC+} - 1$ V under light current-loading conditions. The device can sustain shorts to either supply since output current is internally limited, but care must be taken to ensure that maximum package power dissipation is not exceeded.

Both versions can also be used as comparators. Differential inputs of $V_{CC\pm}$ can be maintained without damage to the device. Open-loop propagation delay with TTL supply levels is typically 200 ns. This gives a good indication as to output stage saturation recovery when the device is driven beyond the limits of recommended output swing.

Both the TLE214x and TLE214xA 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°C to 70°C, I-suffix devices from –40°C to 105°C, and M-suffix devices over the full military temperature range of –55°C to 125°C.

TLE2141 AVAILABLE OPTIONS

T_A	V_{IO}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	500 µV 900 µV	TLE2141ACD TLE2141CD	—	—	TLE2141ACP TLE2141CP	—
–40°C to 105°C	500 µV 900 µV	TLE2141AID TLE2141ID	—	—	TLE2141AIP TLE2141IP	TLE2141Y
–55°C to 125°C	500 µV 900 µV	TLE2141AMD TLE2141MD	TLE2141AMFK TLE2141MFK	TLE2141AMJG TLE2141MJG	TLE2141AMP TLE2141MP	—

† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLE2141ACDR).
‡ Chip forms are tested at T_A = 25°C only.

TLE2142 AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGED DEVICES					CHIP FORM§ (Y)
		SMALL OUTLINE† (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	TSSOP‡ (PW)	
0°C to 70°C	750 µV	TLE2142ACD	—	—	TLE2142ACP	—	—
	1200 µV	TLE2142CD	—	—	TLE2142CP	TLE2142CPWLE	
–40°C to 105°C	750 µV	TLE2142AID	—	—	TLC2142AIP	—	TLE2142Y
	1200 µV	TLE2142ID	—	—	TLC2142IP	—	
–55°C to 125°C	750 µV	TLE2142AMD	TLE2142AMFK	TLE2142AMJG	TLC2142AMP	—	—
	1200 µV	TLE2142MD	TLE2142MFK	TLE2142MJG	TLC2142MP	—	

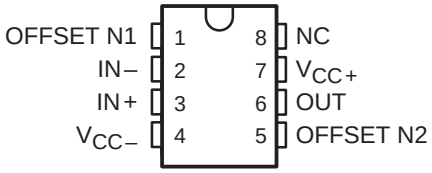
† The D packages are available taped and reeled. Add R suffix to device type (e.g., TLC2142ACDR).
‡ The PW packages are available left-ended taped and reeled. Add LE the suffix to device type (e.g., TLC2142CPWLE).
§ Chip forms are tested at T_A = 25°C only.

TLE2144 AVAILABLE OPTIONS

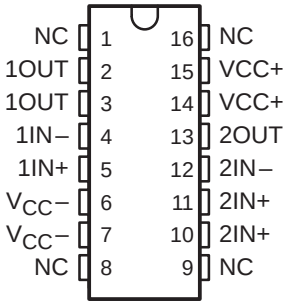
T_A	V_{IO}max AT 25°C	PACKAGED DEVICES				CHIP FORM‡ (Y)
		SMALL OUTLINE† (DW)	CHIP CARRIER (FK)	CERAMIC DIP (J)	PLASTIC DIP (N)	
0°C to 70°C	1.5 mV	—	—	—	TLE2144ACN	—
	2.4 mV	TLE2144CDW	—	—	TLE2144CN	
–40°C to 105°C	1.5 mV	—	—	—	TLE2144AIN	TLE2144Y
	2.4 mV	TLE2144IDW	—	—	TLE2144IN	
–55°C to 125°C	1.5 mV	—	TLE2144AMFK	TLE2144AMJ	TLE2144AMN	—
	2.5 mV	TLE2144MDW	TLE2144MFK	TLE2144MJ	TLE2144MN	

† The DW packages are available taped and reeled. Add R suffix to device type (e.g., TLE2144CDWR).
‡ Chip forms are tested at T_A = 25°C only.

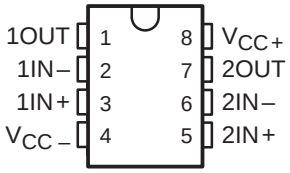
TLE2141
D, JG, OR P PACKAGE
(TOP VIEW)



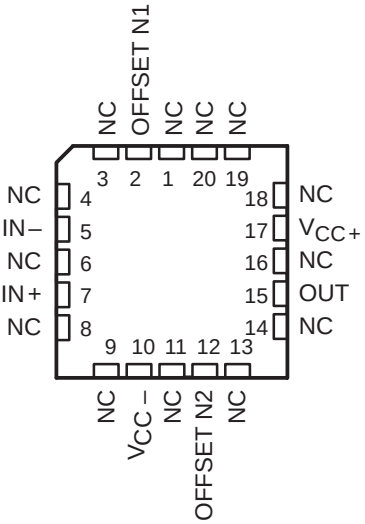
TLE2142
PW PACKAGE
(TOP VIEW)



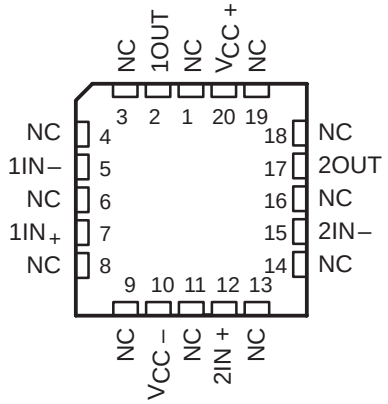
TLE2142
D, JG, OR P PACKAGE
(TOP VIEW)



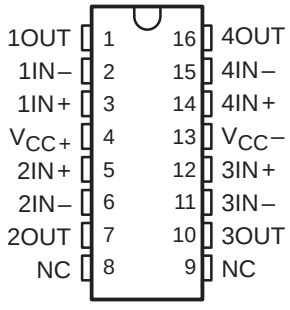
TLE2141
FK PACKAGE
(TOP VIEW)



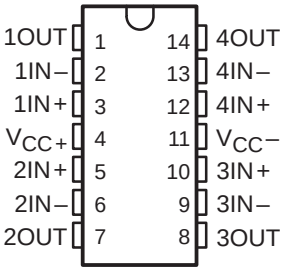
TLE2142
FK PACKAGE
(TOP VIEW)



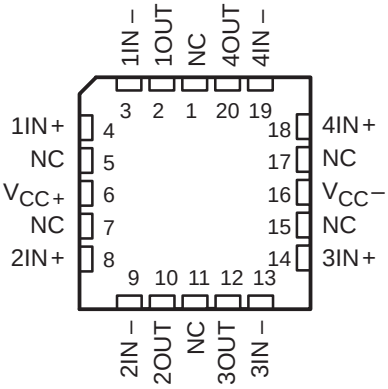
TLE2144
DW PACKAGE
(TOP VIEW)



TLE2144
J OR N PACKAGE
(TOP VIEW)

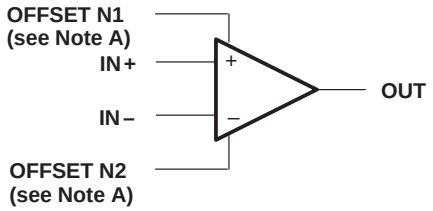


TLE2144
FK PACKAGE
(TOP VIEW)



NC – No internal connection

symbol

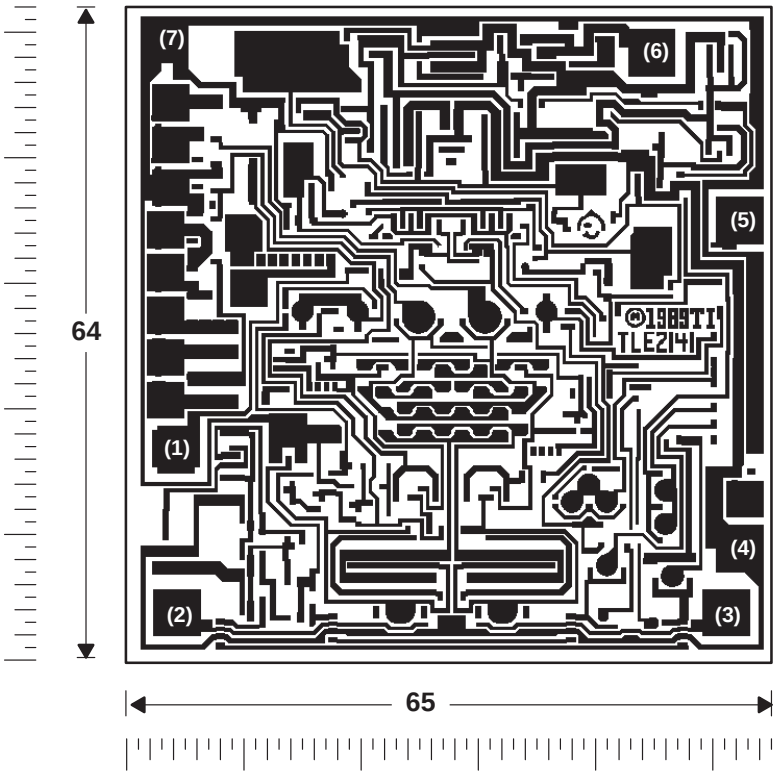


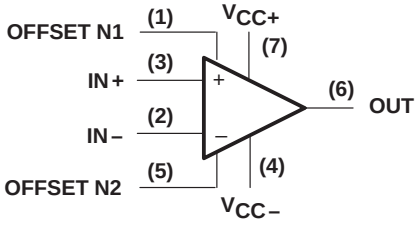
NOTES: A. OFFSET N1 AND OFFSET N2 are only availiable on the TLE2241x devices.

TLE2141Y chip information

This chip, when properly assembled, displays characteristics similar to the TLE2141. 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

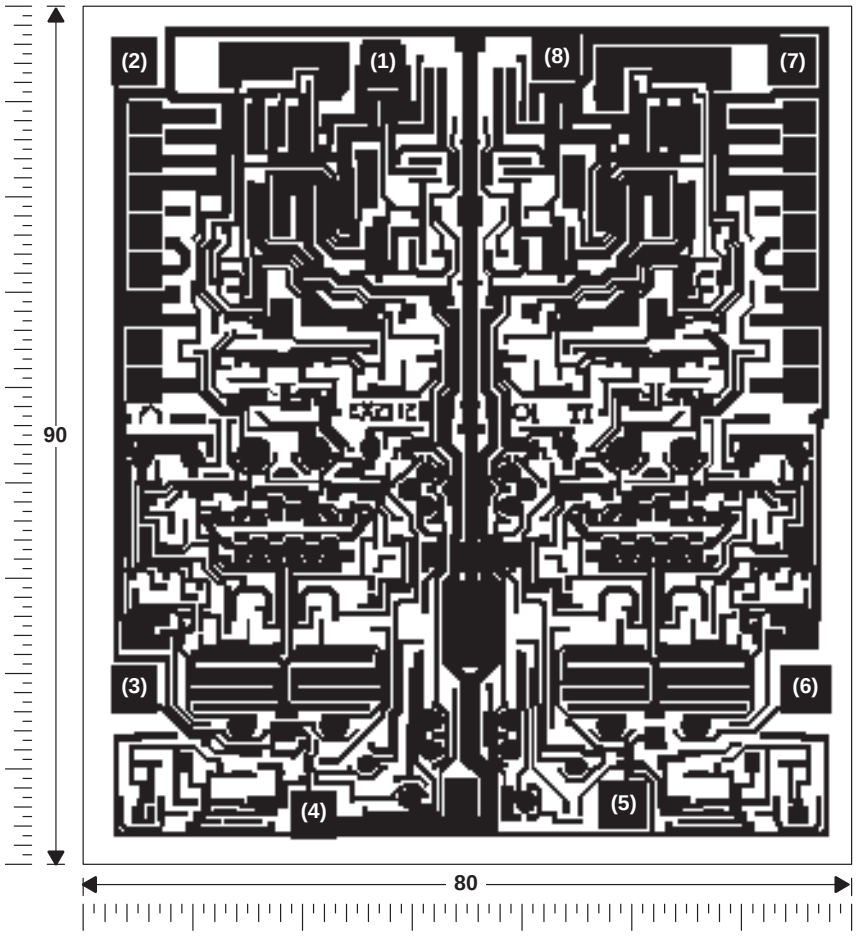
TOLERANCES ARE ±10%.

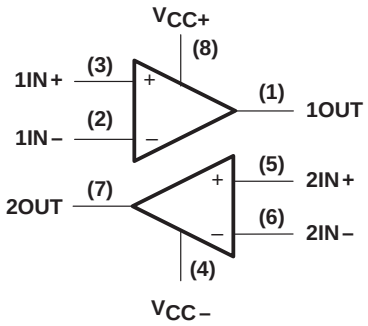
ALL DIMENSIONS ARE IN MILS.

TLE2142Y chip information

This chip, when properly assembled, displays characteristics similar to the TLE2142. 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%.

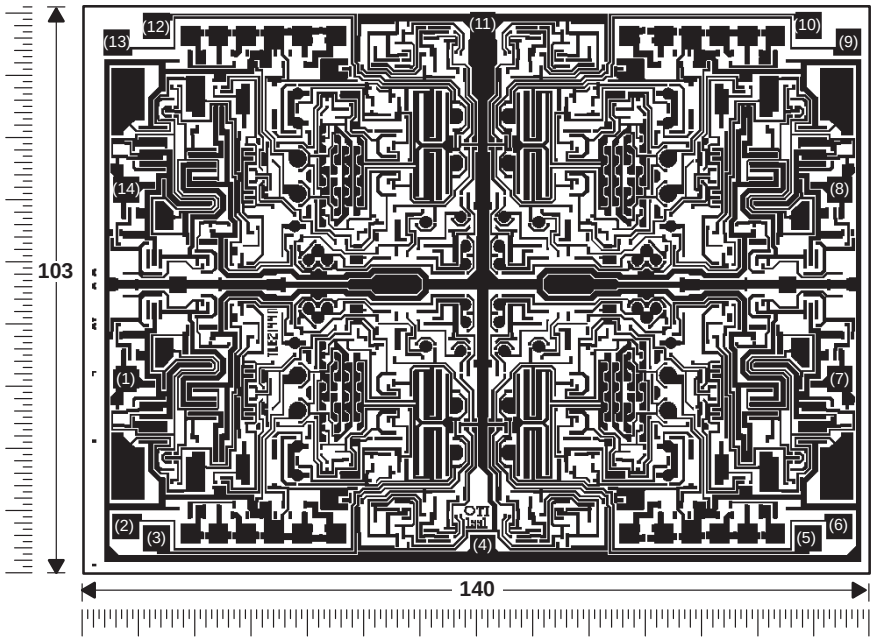
ALL DIMENSIONS ARE IN MILS.

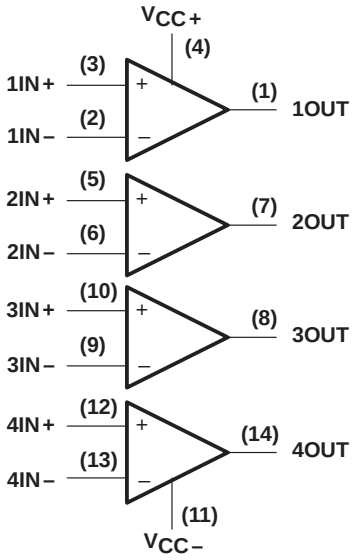
PIN 4 IS INTERNALLY CONNECTED TO BACKSIDE OF CHIP.

TLE2144Y chip information

This chip, when properly assembled, displays characteristics similar to the TLE2144. 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

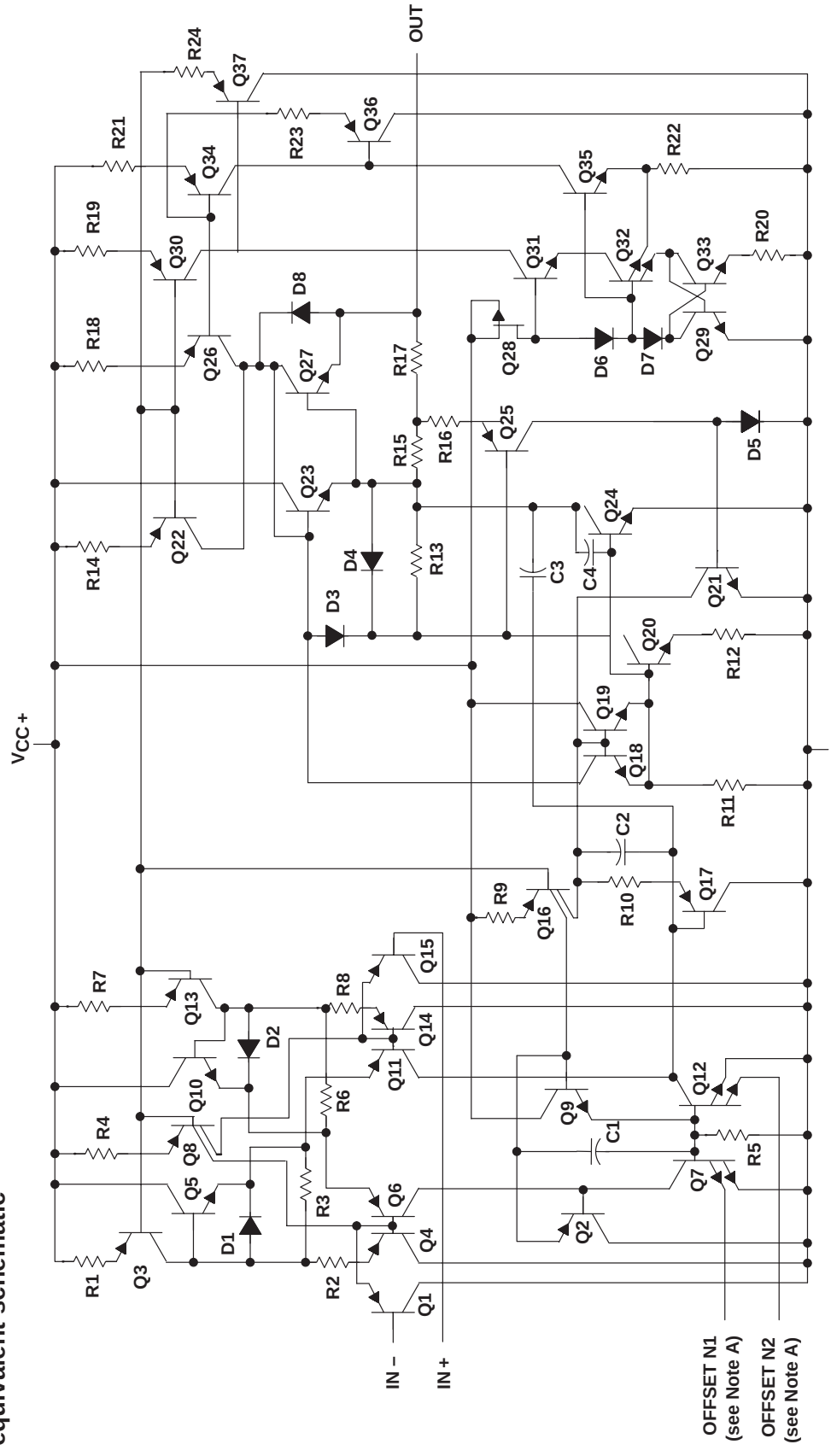
BONDING PADS:
4 × 4 MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

equivalent schematic



NOTE A: OFFSET N1 AND OFFSET N2 are only availiable on the TLE2241x devices.

ACTUAL DEVICE COMPONENT COUNT			
COMPONENT	TLE2241	TLE2242	TLE2244
Transistors	46	65	130
Resistors	24	43	86
Diodes	8	14	28
Capacitors	4	8	16
Epi-FET	1	1	2

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

Supply voltage, V_{CC+} (see Note 1) . . . . . 22 V
Supply voltage, V_{CC-} . . . . . –22 V
Differential input voltage, V_{ID} (see Note 2) . . . . . ±44 V
Input voltage range, V_I (any input) . . . . . V_{CC+} to V_{CC-} – 0.3 V
Input current, I_I (each input) . . . . . ±1 mA
Output current, I_O . . . . . ±80 mA
Total current into V_{CC+} . . . . . 80 mA
Total current out of V_{CC-} . . . . . 80 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 105°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, DW, N, P, or PW package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J or 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–. Excessive current flows if input is brought below V_{CC-} – 0.3 V.
3. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 105°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	261 mW	145 mW
DW	1025 mW	8.2 mW/°C	656 mW	369 mW	205 mW
FK	1375 mW	11.0 mW/°C	880 mW	495 mW	275 mW
J	1375 mW	11.0 mW/°C	880 mW	495 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	378 mW	210 mW
N	1150 mW	9.2 mW/°C	736 mW	414 mW	230 mW
P	1000 mW	8.0 mW/°C	640 mW	360 mW	200 mW
PW	525 mW	4.2 mW/°C	336 mW	—	—

recommended operating conditions

		C SUFFIX		I SUFFIX		M SUFFIX		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC\pm}$		±2	±22	±2	±22	±2	±22	V
Common-mode input voltage, V_{IC}	V_{CC} = 5 V	0	2.9	0	2.7	0	2.7	V
	$V_{CC\pm}$ = ±15 V	–15	12.9	–15	12.7	–15	12.7	
Operating free-air temperature, T_A		0	70	–40	105	–55	125	°C

TLE2141C electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2141C			TLE2141AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, R_S = 50 Ω, V_{IC} = 2.5 V	25°C		225	1400		200	1000	μV
			Full range			1700			1300	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			150			150	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.1			−2.1	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.9			0 to 2.9			
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
			Full range	3.8			3.8			
		I_{OH} = −1.5 mA	25°C	3.8	4		3.8	4		
			Full range	3.7			3.7			
		I_{OH} = −15 mA	25°C	3.2	3.7		3.2	3.7		
			Full range	3.2			3.2			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
			Full range			150			150	
		I_{OL} = 1.5 mA	25°C		150	225		150	225	
			Full range			250			250	
		I_{OL} = 15 mA	25°C		1.2	1.6		1.2	1.6	V
			Full range			1.7			1.7	
A_{VD}	Large-signal differential voltage amplification	V_{CC} = ±2.5 V, R_L = 2 kΩ, V_O = 1 V to −1.5 V	25°C	50	220		50	220		V/mV
			Full range	25			25			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, No load, V_{IC} = 2.5 V	25°C		3.4	4.4		3.4	4.4	mA
			Full range			4.6			4.6	

† Full range is 0°C to 70°C.

TLE2141C operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2141C			TLE2141AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF†,	R_L = 2 kΩ,†		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF†		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF†,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF†		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF†		57°			57°		

† R_L and C_L terminated to 2.5 V.

TLE2141C electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2141C			TLE2141AC			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,	25°C		200	900		175	500	μV
				Full range			1300			800	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			150			150	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.6			−1.6	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.9	−15.3 to 13.1		−15 to 12.9	−15.3 to 13.1		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
				Full range	13.7			13.7			
		I_O = −1.5 mA		25°C	13.7	14		13.7	14		
				Full range	13.6			13.6			
		I_O = −15 mA		25°C	13.1	13.7		13.1	13.7		
				Full range	13			13			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
				Full range	−14.6			−14.6			
		I_O = 1.5 mA		25°C	−14.5	−14.8		−14.5	−14.8		
				Full range	−14.4			−14.4			
		I_O = 15 mA		25°C	−13.4	−13.8		−13.4	−13.8		
				Full range	−13.3			−13.3			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V		25°C	100	450		100	450		V/mV
				Full range	75			75			
r_i	Input resistance	R_L = 2 kΩ		25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0,	No load	25°C		3.5	4.5		3.5	4.5	mA
				Full range			4.7			4.7	

† Full range is 0°C to 70°C.

TLE2141C operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2141C			TLE2141AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2142C electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2142C			TLE2142AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, R_S = 50 Ω, V_{IC} = 2.5 V	25°C		220	1900		200	1500	μV
			Full range			2200			1800	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			150			150	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.1			−2.1	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.9			0 to 2.9			
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
			Full range	3.8			3.8			
		I_{OH} = −1.5 mA	25°C	3.8	4		3.8	4		
			Full range	3.7			3.7			
		I_{OH} = −15 mA	25°C	3.4	3.7		3.4	3.7		
			Full range	3.4			3.4			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
			Full range			150			150	
		I_{OL} = 1.5 mA	25°C		150	225		150	225	
			Full range			250			250	
		I_{OL} = 15 mA	25°C		1.2	1.4		1.2	1.4	V
			Full range			1.5			1.5	
A_{VD}	Large-signal differential voltage amplification	V_{CC} = ±2.5 V, R_L = 2 kΩ, V_O = 1 V to −1.5 V	25°C	50	220		50	220		V/mV
			Full range	25			25			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, No load, V_{IC} = 2.5 V	25°C		6.6	8.8		6.6	8.8	mA
			Full range			9.2			9.2	

† Full range is 0°C to 70°C.

TLE2142C operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142C			TLE2142AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF		57°			57°		

† R_L terminates at 2.5 V.

TLE2142C electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2142C			TLE2142AC			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,	25°C		290	1200		275	750	μV
				Full range			1600			1200	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			150			150	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.6			−1.6	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.9	−15.3 to 13.1		−15 to 12.9	−15.3 to 13.1		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
				Full range	13.7			13.7			
		I_O = −1.5 mA		25°C	13.7	14		13.7	14		
				Full range	13.6			13.6			
		I_O = −15 mA		25°C	13.3	13.7		13.3	13.7		
				Full range	13.2			13.2			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
				Full range	−14.6			−14.6			
		I_O = 1.5 mA		25°C	−14.5	−14.8		−14.5	−14.8		
				Full range	−14.4			−14.4			
		I_O = 15 mA		25°C	−13.4	−13.8		−13.4	−13.8		
				Full range	−13.3			−13.3			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V		25°C	100	450		100	450		V/mV
				Full range	75			75			
r_i	Input resistance	R_L = 2 kΩ		25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω		25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ± 2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0,	No load	25°C		6.9	9		6.9	9	mA
				Full range			9.4			9.4	

† Full range is 0°C to 70°C.

TLE2142C operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142C			TLE2142AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ,, f =100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2144C electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2144C			TLE2144AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, V_{IC} = 2.5 V, R_S = 50 Ω	25°C		0.5	3.8		0.5	3	mV
			Full range			4.4			3.6	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			150			150	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.1			−2.1	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.9			0 to 2.9			
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
			Full range	3.8			3.8			
		I_{OH} = −1.5 mA	25°C	3.8	4		3.8	4		
			Full range	3.7			3.7			
		I_{OH} = −15 mA	25°C	3.4	3.7		3.4	3.7		
			Full range	3.4			3.4			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
			Full range			150			150	
		I_{OL} = 1.5 mA	25°C		150	225		150	225	
			Full range			250			250	
		I_{OL} = 15 mA	25°C		1.2	1.6		1.2	1.6	V
			Full range			1.7			1.7	
A_{VD}	Large-signal differential voltage amplification	V_{CC} = ±2.5 V, V_O = 1 V to −1.5 V, R_L = 2 kΩ,	25°C	50	95		50	95		V/mV
			Full range	25			25			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, V_{IC} = 2.5 V, No load,	25°C		13.2	17.6		13.2	17.6	mA
			Full range			18.5			18.5	

† Full range is 0°C to 70°C.

TLE2144C operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2144C			TLE2144AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF		57°			57°		

† R_L terminates at 2.5 V

TLE2144C electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2144C			TLE2144AC			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,	25°C		0.6	2.4		0.5	1.5	mV
				Full range			3.2			2.4	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			150			150	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.6			−1.6	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.9	−15.3 to 13.1		−15 to 12.9	−15 to 13.1		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
				Full range	13.7			13.7			
		I_O = −1.5 mA		25°C	13.7	14		13.7	14		
				Full range	13.6			13.6			
		I_O = −15 mA		25°C	13.1	13.7		13.1	13.7		
				Full range	13			13			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
				Full range	−14.6			−14.6			
		I_O = 1.5 mA		25°C	−14.5	−14.8		−14.5	−14.8		
				Full range	−14.4			−14.4			
		I_O = 15 mA		25°C	−13.4	−13.8		−13.4	−13.8		
				Full range	−13.3			−13.3			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V		25°C	100	170		100	170		V/mV
				Full range	75			75			
r_i	Input resistance	R_L = 2 kΩ		25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0,	No load	25°C		13.8	18		13.8	18	mA
				Full range			18.8			18.8	

† Full range is 0°C to 70°C.

TLE2144C operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2144C			TLE2144AC			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ,	27	45		27	45		V/μs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		μs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		μV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2141I electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2141I			TLE2141AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, R_S = 50 Ω, V_{IC} = 2.5 V	25°C		225	1400		200	1000	μV
			Full range			1900			1500	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			200			200	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.2			−2.2	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.7	−0.3 to 2.9		0 to 2.7	−0.3 to 2.9		
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
		I_{OH} = −1.5 mA		3.8	4		3.8	4		
		I_{OH} = −15 mA		3.2	3.7		3.2	3.7		
		I_{OH} = −100 μA	Full range	3.8			3.8			
		I_{OH} = −1 mA		3.7			3.7			
		I_{OH} = −10 mA		3.3			3.3			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
		I_{OL} = 1.5 μA			150	225		150	225	
		I_{OL} = 15 mA			1.2	1.6		1.2	1.6	V
		I_{OL} = 100 μA	Full range			175			175	mV
		I_{OL} = 1 mA				225			225	
		I_{OL} = 10 mA				1.4			1.4	V
A_{VD}	Large-signal differential voltage amplification	V_{CC} = ±2.5 V, R_L = 2 kΩ, V_O = 1 V to −1.5 V	25°C	50	220		50	220		V/mV
			Full range	10			10			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, No load, V_{IC} = 2.5 V	25°C		3.4	4.4		3.4	4.4	mA
			Full range			4.6			4.6	

† Full range is −40°C to 105°C.

TLE2141I operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2141I			TLE2141AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF†		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ† f = 100 kHz	C_L = 100 pF†,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF†		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF†		57°			57°		

† R_L and C_L terminated to 2.5 V.

TLE2141I electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2141I			TLE2141AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,	25°C		200	900		175	500	μV
				Full range			1500			1000	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			200			200	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.7			−1.7	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.7	−15.3 to 12.9		−15 to 12.7	−15.3 to 12.9		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
		I_O = −1.5 mA			13.7	14		13.7	14		
		I_O = −15 mA			13.1	13.7		13.1	13.7		
		I_O = −100 μA		Full range	13.7			13.7			
		I_O = −1 mA			13.6			13.6			
		I_O = −10 mA			13.1			13.1			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
		I_O = 1.5 mA			−14.5	−14.8		−14.5	−14.8		
		I_O = 15 mA			−13.4	−13.8		−13.4	−13.8		
		I_O = 100 μA		Full range	−14.6			−14.6			
		I_O = 1 mA			−14.5			−14.5			
		I_O = 10 mA			−13.4			−13.4			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	25°C	100	450		100	450		V/mV
				Full range	40			40			
r_i	Input resistance			25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω		25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0,	No load	25°C		3.5	4.5		3.5	4.5	mA
				Full range			4.7			4.7	

† Full range is −40°C to 105°C.

TLE2141I operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2141I			TLE2141AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2142I electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2142I			TLE2142AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, V_{IC} = 2.5 V	R_S = 50 Ω,	25°C		220	1900		220	1500	μV
				Full range			2400			2000	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		8	100		8	100	nA
				Full range			200			200	
I_{IB}	Input bias current			25°C		−0.8	−2		−0.8	−2	μA
				Full range			−2.2			−2.2	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
				Full range	0 to 2.7	−0.3 to 2.9		0 to 2.7	−0.3 to 2.9		
V_{OH}	High-level output voltage	I_{OH} = −150 μA		25°C	3.9	4.1		3.9	4.1		V
		I_{OH} = −1.5 mA			3.8	4		3.8	4		
		I_{OH} = −15 mA			3.4	3.7		3.4	3.7		
		I_{OH} = 100 μA		Full range	3.8			3.8			
		I_{OH} = 1 mA			3.7			3.7			
		I_{OH} = 10 mA			3.5			3.5			
V_{OL}	Low-level output voltage	I_{OI} = 150 μA		25°C		75	125		75	125	mV
		I_{OL} = 1.5 mA				150	225		150	225	
		I_{OL} = 15 mA				1.2	1.4		1.2	1.4	V
		I_{OL} = 100 μA		Full range			175			175	mV
		I_{OL} = 1 mA					225			225	
		I_{OL} = 10 mA					1.2			1.2	V
A_{VD}	Large-signal differential voltage amplification	V_{IC} = ±2.5 V, V_O = 1 V to −1.5 V	R_L = 2 kΩ,	25°C	50	220		50	220		V/mV
				Full range	10			10			
r_i	Input resistance			25°C		70			70		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	25°C	85	118		85	118		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}$ /ΔV_{IO})	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, V_{IC} = 2.5 V	No load,	25°C		6.6	8.8		6.6	8.8	mA
				Full range			9.2			9.2	

† Full range is – 40°C to 105°C.

TLE2142I operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142I			TLE2142AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF		57°			57°		

† R_L terminates at 2.5 V.

TLE2142I electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2142I			TLE2142I			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,	25°C		290	1200		275	750	μV
				Full range			1800			1400	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			200			200	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.7			−1.7	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.7	−15.3 to 12.9		−15 to 12.7	−15.3 to 12.9		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
		I_O = −1.5 mA			13.7	14		13.7	14		
		I_O = −15 mA			13.3	13.7		13.3	13.7		
		I_O = −100 μA		Full range	13.7			13.7			
		I_O = −1 mA			13.6			13.6			
		I_O = −10 mA			13.3			13.3			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
		I_O = 1.5 mA			−14.5	−14.8		−14.5	−14.8		
		I_O = 15 mA			−13.4	−13.8		−13.4	−13.8		
		I_O = 100 μA		Full range	−14.6			−14.6			
		I_O = 1 mA			−14.5			−14.5			
		I_O = 10 mA			−13.4			−13.4			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	25°C	100	450		100	450		V/mV
				Full range	40			40			
r_i	Input resistance			25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min		25°C	85	108		85	108		dB
		R_S = 50 Ω		Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}$ /ΔV_{IO})	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0,	No load	25°C		6.9	9		6.9	9	mA
				Full range			9.4			9.4	

† Full range is −40°C to 105°C.

TLE2142I operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142I			TLE2142AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ,	30	45		30	45		V/µs
SR–	Negative slew rate			30	42		30	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f =100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2144I electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2144I			TLE2144AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω, V_O = 0	25°C		0.5	3.8		0.5	3	mV
			Full range			4.8			4	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		µV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			200			200	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	µA
			Full range			−2.2			−2.2	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.7	−0.3 to 2.9		0 to 2.7	−0.3 to 2.9		
V_{OH}	High-level output voltage	I_{OH} = −150 µA	25°C	3.9	4.1		3.9	4.1		V
		I_{OH} = −1.5 mA		3.8	4		3.8	4		
		I_{OH} = −15 mA		3.4	3.7		3.4	3.7		
		I_{OH} = 100 µA	Full range	3.8			3.8			
		I_{OH} = 1 mA		3.7			3.7			
		I_{OH} = 10 mA		3.5			3.5			
V_{OL}	Low-level output voltage	I_{OL} = 150 µA	25°C		75	125		75	125	mV
		I_{OL} = 1.5 µA			150	225		150	225	
		I_{OL} = 15 mA			1.2	1.6		1.2	1.6	V
		I_{OL} = 100 µA	Full range			175			175	mV
		I_{OL} = 1 mA				225			225	
		I_{OL} = 10 mA				1.4			1.4	V
A_{VD}	Large-signal differential voltage amplification	V_{IC} = ±2.5 V, R_L = 2 kΩ, V_O = 1 V to −1.5 V	25°C	50	95		50	95		V/mV
			Full range	10			10			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, No load, V_{IC} = 2.5 V	25°C		13.2	17.6		13.2	17.6	mA
			Full range			18.4			18.4	

† Full range is −40°C to 105°C.

TLE2144I operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2144I			TLE2144AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 10 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF		57°			57°		

† R_L terminates at 2.5 V

TLE2144I electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2144I			TLE2144AI			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,	25°C		0.6	2.4		0.5	1.5	mV
				Full range			3.2			2.8	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		µV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			200			200	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	µA
				Full range			−1.7			−1.7	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.7	−15.3 to 12.9		−15 to 12.7	−15.3 to 12.9		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 µA		25°C	13.8	14.1		13.8	14.1		V
		I_O = −1.5 mA			13.7	14		13.7	14		
		I_O = −15 mA			13.1	13.7		13.1	13.7		
		I_O = −100 µA		Full range	13.7			13.7			
		I_O = −1 mA			13.6			13.6			
		I_O = −10 mA			13.1			13.1			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 µA		25°C	−14.7	−14.9		−14.7	−14.9		V
		I_O = 1.5 mA			−14.5	−14.8		−14.5	−14.8		
		I_O = 15 mA			−13.4	−13.8		−13.4	−13.8		
		I_O = 100 µA		Full range	−14.6			−14.6			
		I_O = 1 mA			−14.5			−14.5			
		I_O = 10 mA			−13.4			−13.4			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	25°C	100	170		100	170		V/mV
				Full range	40			40			
r_i	Input resistance			25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0,	No load	25°C		13.8	18		13.8	18	mA
				Full range			18.8			18.8	

† Full range is −40°C to 105°C.

TLE2144I operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2144I			TLE2144AI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2141M electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2141M			TLE2141AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, V_{IC} = 2.5 V, R_S = 50 Ω	25°C		225	1400		200	1000	μV
			Full range			2100			1700	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			250			250	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.3			−2.3	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.7	−0.3 to 2.9		0 to 2.7	−0.3 to 2.9		
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
		I_{OH} = −1.5 mA		3.8	4		3.8	4		
		I_{OH} = −15 mA		3.2	3.7		3.2	3.7		
		I_{OH} = −100 μA	Full range	3.75			3.75			
		I_{OH} = −1 mA		3.65			3.65			
		I_{OH} = −10 mA		3.25			3.25			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
		I_{OL} = 1.5 μA			150	225		150	225	
		I_{OL} = 15 mA			1.2	1.4		1.2	1.4	V
		I_{OL} = 100 μA	Full range			200			200	mV
		I_{OL} = 1 mA				250			225	
		I_{OL} = 10 mA				1.25			1.25	V
A_{VD}	Large-signal differential voltage amplification	V_{IC} = ±2.5 V, V_O = 1 V to −1.5 V, R_L = 2 kΩ	25°C	50	220		50	220		V/mV
			Full range	5			5			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, V_{IC} = 2.5 V, No load	25°C		3.4	4.4		3.4	4.4	mA
			Full range			4.6			4.6	

† Full range is −55°C to 125°C.

TLE2141M operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2141M			TLE2141AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF†		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF†,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1	R_L = 2 kΩ†,		660			660		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ†,	C_L = 100 pF†		57°			57°		

† R_L and C_L terminated to 2.5 V.

TLE2141M electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2141M			TLE2141AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0,	R_S = 50 Ω	25°C		200	900		175	500	μV
				Full range			1700			1200	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			250			250	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.8			−1.8	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.7	−15.3 to 12.9		−15 to 12.7	−15.3 to 12.9		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
		I_O = −1.5 mA			13.7	14		13.7	14		
		I_O = −15 mA			13.1	13.7		13.1	13.7		
		I_O = −100 μA		Full range	13.7			13.7			
		I_O = −1 mA			13.6			13.6			
		I_O = −10 mA			13.1			13.1			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
		I_O = 1.5 mA			−14.5	−14.8		−14.5	−14.8		
		I_O = 15 mA			−13.4	−13.8		−13.4	−13.8		
		I_O = 100 μA		Full range	−14.6			−14.6			
		I_O = 1 mA			−14.5			−14.5			
		I_O = 10 mA			−13.4			−13.4			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	25°C	100	450		100	450		V/mV
				Full range	20			20			
r_i	Input resistance			25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V,	R_S = 50 Ω	25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0, V_{IC} = 2.5 V	No load,	25°C		3.5	4.5		3.5	4.5	mA
				Full range			4.7			4.7	

† Full range is −55°C to 125°C.

TLE2141M operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2141M			TLE2141AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 100 pF	R_L = 2 kΩ,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2142M electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2142M			TLE2142AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, R_S = 50 Ω, V_{IC} = 2.5 V	25°C		220	1900		200	1500	μV
			Full range			2600			2200	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			200			200	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.3			−2.3	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.7	−0.3 to 2.9		0 to 2.7	−0.3 to 2.9		
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
		I_{OH} = −1.5 mA		3.8	4		3.8	4		
		I_{OH} = −15 mA		3.4	3.7		3.4	3.7		
		I_{OH} = 100 μA	Full range	3.75			3.75			
		I_{OH} = 1 mA		3.65			3.65			
		I_{OH} = 10 mA		3.45			3.45			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
		I_{OL} = 1.5 mA			150	225		150	225	
		I_{OL} = 15 mA			1.2	1.4		1.2	1.4	V
		I_{OL} = 100 μA	Full range			200			200	mV
		I_{OL} = 1 mA				250			250	
		I_{OL} = 10 mA				1.25			1.25	V
A_{VD}	Large-signal differential voltage amplification	V_{IC} = ±2.5 V, R_L = 2 kΩ, V_O = 1 V to −1.5 V	25°C	50	220		50	220		V/mV
			Full range	5			5			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, No load, V_{IC} = 2.5 V	25°C		6.6	8.8		6.6	8.8	mA
			Full range			9.2			9.2	

† Full range is – 55°C to 125°C.

TLE2142M operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142M			TLE2142AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1,	R_L = 2 kΩ†, C_L = 100 pF		660			660		kHz
ϕ_m	Phase margin	R_L = 2 kΩ†,	C_L = 100 pF		57°			57°		

† R_L terminates at 2.5 V.

TLE2142M electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2142M			TLE2142AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0,	R_S = 50 Ω	25°C		290	1200		275	750	μV
				Full range			2000			1600	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			250			250	
I_{IB}	Input bias current			25°C		−0.7	−1.5		−0.7	−1.5	μA
				Full range			−1.8			−1.8	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	−15 to 13	−15.3 to 13.2		−15 to 13	−15.3 to 13.2		V
				Full range	−15 to 12.7	−15.3 to 12.9		−15 to 12.7	−15.3 to 12.9		
V_{OM+}	Maximum positive peak output voltage swing	I_O = −150 μA		25°C	13.8	14.1		13.8	14.1		V
		I_O = −1.5 mA			13.7	14		13.7	14		
		I_O = −15 mA			13.3	13.7		13.3	13.7		
		I_O = −100 μA		Full range	13.7			13.7			
		I_O = −1 mA			13.6			13.6			
		I_O = −10 mA			13.3			13.3			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 μA		25°C	−14.7	−14.9		−14.7	−14.9		V
		I_O = 1.5 mA			−14.5	−14.8		−14.5	−14.8		
		I_O = 15 mA			−13.4	−13.8		−13.4	−13.8		
		I_O = 100 μA		Full range	−14.6			−14.6			
		I_O = 1 mA			−14.5			−14.5			
		I_O = 10 mA			−13.4			−13.4			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	25°C	100	450		100	450		V/mV
				Full range	20			20			
r_i	Input resistance			25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω		25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	−25	−50		−25	−50		mA
			V_{ID} = −1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0, V_{IC} = 2.5 V	No load,	25°C		6.9	9		6.9	9	mA
				Full range			9.4			9.4	

† Full range is −55°C to 125°C.

TLE2142M operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142M			TLE2142AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	R_L = 2 kΩ, C_L = 100 pF	A_{VD} = –1,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		0.4			0.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 1 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2144M electrical characteristics at specified free-air temperature, V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLE2144M			TLE2144AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_O = 2.5 V, R_S = 50 Ω, V_{IC} = 2.5 V	25°C		0.5	3.8		0.5	3	mV
			Full range			5.2			4.4	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		1.7			1.7		μV/°C
I_{IO}	Input offset current		25°C		8	100		8	100	nA
			Full range			250			250	
I_{IB}	Input bias current		25°C		−0.8	−2		−0.8	−2	μA
			Full range			−2.3			−2.3	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	25°C	0 to 3	−0.3 to 3.2		0 to 3	−0.3 to 3.2		V
			Full range	0 to 2.7	−0.3 to 2.9		0 to 2.7	−0.3 to 2.9		
V_{OH}	High-level output voltage	I_{OH} = −150 μA	25°C	3.9	4.1		3.9	4.1		V
		I_{OH} = −1.5 mA		3.8	4		3.8	4		
		I_{OH} = −15 mA		3.4	3.7		3.4	3.7		
		I_{OH} = 100 μA	Full range	3.75			3.75			
		I_{OH} = 1 mA		3.65			3.65			
		I_{OH} = 10 mA		3.45			3.45			
V_{OL}	Low-level output voltage	I_{OL} = 150 μA	25°C		75	125		75	125	mV
		I_{OL} = 1.5 μA			150	225		150	225	
		I_{OL} = 15 mA			1.2	1.6		1.2	1.6	V
		I_{OL} = 100 μA	Full range			200			200	mV
		I_{OL} = 1 mA				250			250	
		I_{OL} = 10 mA				1.45			1.45	V
A_{VD}	Large-signal differential voltage amplification	V_{IC} = ±2.5 V, R_L = 2 kΩ, V_O = 1 V to −1.5 V	25°C	50	95		50	95		V/mV
			Full range	5			5			
r_i	Input resistance		25°C		70			70		MΩ
c_i	Input capacitance		25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz	25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω	25°C	85	118		85	118		dB
			Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω	25°C	90	106		90	106		dB
			Full range	85			85			
I_{CC}	Supply current	V_O = 2.5 V, No load, V_{IC} = 2.5 V	25°C		13.2	17.6		13.2	17.6	mA
			Full range			18.4			18.4	

† Full range is −55°C to 125°C.

TLE2144M operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2144M			TLE2144AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	A_{VD} = –1, C_L = 500 pF	R_L = 2 kΩ†,		45			45		V/µs
SR–	Negative slew rate				42			42		
t_s	Settling time	A_{VD} = –1, 2.5-V step	To 0.1%		0.16			0.16		µs
			To 0.01%		0.22			0.22		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.92			1.92		pA/√Hz
		f = 1 kHz			0.5			0.5		
THD + N	Total harmonic distortion plus noise	V_O = 1 V to 3 V, A_{VD} = 2,	R_L = 2 kΩ†, f = 10 kHz		0.0052%			0.0052%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ†,	C_L = 100 pF		5.9			5.9		MHz
	Gain-bandwidth product	R_L = 2 kΩ†, f = 100 kHz	C_L = 100 pF,		5.8			5.8		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 2 V, A_{VD} = 1	R_L = 2 kΩ†,		660			660		kHz
ϕ_m	Phase margin	R_L = 2 kΩ†,	C_L = 100 pF		57°			57°		

† R_L terminates at 2.5 V

TLE2144M electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A†	TLE2144M			TLE2144AM			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0,	R_S = 50 Ω	25°C		0.6	2.4		0.5	1.5	mV
				Full range			4			3.2	
α_{VIO}	Temperature coefficient of input offset voltage			Full range		1.7			1.7		µV/°C
I_{IO}	Input offset current			25°C		7	100		7	100	nA
				Full range			250			250	
I_{IB}	Input bias current			25°C		–0.7	–1.5		–0.7	–1.5	µA
				Full range			–1.8			–1.8	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		25°C	–15 to 13	–15.3 to 13.2		–15 to 13	–15.3 to 13.2		V
				Full range	–15 to 12.7	–15.3 to 12.9		–15 to 12.7	–15.3 to 12.9		
V_{OM+}	Maximum positive peak output voltage swing	I_O = –150 µA		25°C	13.8	14.1		13.8	14.1		V
		I_O = –1.5 mA			13.7	14		13.7	14		
		I_O = –15 mA			13.1	13.7		13.1	13.7		
		I_O = –100 µA		Full range	13.7			13.7			
		I_O = –1 mA			13.6			13.6			
		I_O = –10 mA			13.1			13.1			
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 µA		25°C	–14.7	–14.9		–14.7	–14.9		V
		I_O = 1.5 mA			–14.5	–14.8		–14.5	–14.8		
		I_O = 15 mA			–13.4	–13.8		–13.4	–13.8		
		I_O = 100 µA		Full range	–14.6			–14.6			
		I_O = 1 mA			–14.5			–14.5			
		I_O = 10 mA			–13.4			–13.4			
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	25°C	100	170		100	170		V/mV
				Full range	20			20			
r_i	Input resistance			25°C		65			65		MΩ
c_i	Input capacitance			25°C		2.5			2.5		pF
z_o	Open-loop output impedance	f = 1 MHz		25°C		30			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	25°C	85	108		85	108		dB
				Full range	80			80			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		25°C	90	106		90	106		dB
				Full range	85			85			
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	25°C	–25	–50		–25	–50		mA
			V_{ID} = –1 V		20	31		20	31		
I_{CC}	Supply current	V_O = 0, V_{IC} = 2.5 V	No load,	25°C		13.8	18		13.8	18	mA
				Full range			18.8			18.8	

† Full range is –55°C to 125°C

TLE2144M operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2144M			TLE2144AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR+	Positive slew rate	R_L = 2 kΩ, C_L = 100 pF	A_{VD} = –1,	27	45		27	45		V/µs
SR–	Negative slew rate			27	42		27	42		
t_s	Settling time	A_{VD} = –1, 10-V step	To 0.1%		0.34			0.34		µs
			To 0.01%		.4			.4		
V_n	Equivalent input noise voltage	R_S = 20 Ω,	f = 10 Hz		15			15		nV/√Hz
		R_S = 20 Ω,	f = 1 kHz		10.5			10.5		
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 Hz to 1 Hz			0.48			0.48		µV
		f = 0.1 Hz to 10 Hz			0.51			0.51		
I_n	Equivalent input noise current	f = 10 Hz			1.89			1.89		pA/√Hz
		f = 10 kHz			0.47			0.47		
THD + N	Total harmonic distortion plus noise	$V_{O(PP)}$ = 20 V, A_{VD} = 10,	R_L = 2 kΩ, f = 10 kHz		0.01%			0.01%		
B_1	Unity-gain bandwidth	R_L = 2 kΩ,	C_L = 100 pF		6			6		MHz
	Gain-bandwidth product	R_L = 2 kΩ, f = 100 kHz	C_L = 100 pF,		5.9			5.9		MHz
B_{OM}	Maximum output-swing bandwidth	$V_{O(PP)}$ = 20 V, A_{VD} = 1,	R_L = 2 kΩ, C_L = 100 pF		668			668		kHz
ϕ_m	Phase margin at unity gain	R_L = 2 kΩ,	C_L = 100 pF		58°			58°		

TLE2141Y electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		TLE2141Y			UNIT
				MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0, R_S = 50 Ω,			200	1000	μV
I_{IO}	Input offset current				7	100	nA
I_{IB}	Input bias current				–0.7	–1.5	μA
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		–15 to 13	–15.3 to 13.2		V
V_{OM+}	Maximum positive peak output voltage swing	I_O = –150 μA		13.8	14.1		V
		I_O = –1.5 mA		13.7	14		
		I_O = –15 mA		13.3	13.7		
$V_{OM–}$	Maximum negative peak output voltage swing	I_O = 150 μA		–14.7	–14.9		V
		I_O = 1.5 mA		–14.5	–14.8		
		I_O = 15 mA		–13.4	–13.8		
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V, R_L = 2 kΩ		100	450		V/mV
r_i	Input resistance				65		MΩ
c_i	Input capacitance				2.5		pF
z_o	Open-loop output impedance	f = 1 MHz			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, R_S = 50 Ω		80	108		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		85	106		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	–25	–50		mA
			V_{ID} = –1 V	20	31		
I_{CC}	Supply current	V_O = 0,	No load		3.5	4.5	mA

TLE2142Y electrical characteristics at specified free-air temperature, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TLE2142Y			UNIT
				MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0	R_S = 50 Ω,		150	875	μV
I_{IO}	Input offset current				7	100	nA
I_{IB}	Input bias current				–0.7	–1.5	μA
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		–15 to 13	–15.3 to 13.2		V
V_{OM+}	Maximum positive peak output voltage swing	I_O = –150 μA		13.8	14.1		V
		I_O = –1.5 mA		13.7	14		
		I_O = –15 mA		13.3	13.7		
$V_{OM–}$	Maximum negative peak output voltage swing	I_O = 150 μA		–14.7	–14.9		V
		I_O = 1.5 mA		–14.5	–14.8		
		I_O = 15 mA		–13.4	–13.8		
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	100	450		V/mV
r_i	Input resistance				65		MΩ
c_i	Input capacitance				2.5		pF
z_o	Open-loop output impedance	f = 1 MHz			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	80	108		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V, R_S = 50 Ω		85	106		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	–25	–50		mA
			V_{ID} = –1 V	20	31		
I_{CC}	Supply current	V_O = 0,	No load		6.9	9	mA

TLE2144Y electrical characteristics at $V_{CC\pm}$ = ±15 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		TLE2144Y			UNIT
				MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, V_O = 0, R_S = 50 Ω,			0.3	1.8	mV
I_{IO}	Input offset current				7	100	nA
I_{IB}	Input bias current				–0.7	–1.5	µA
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω		–15 to 13	–15.3 to 13.2		V
V_{OM+}	Maximum positive peak output voltage swing	I_O = –150 µA		13.8	14.1		V
		I_O = –1.5 mA		13.7	14		
		I_O = –15 mA		13.3	13.7		
V_{OM-}	Maximum negative peak output voltage swing	I_O = 150 µA		–14.7	–14.9		V
		I_O = 1.5 mA		–14.5	–14.8		
		I_O = 15 mA		–13.4	–13.8		
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V,	R_L = 2 kΩ	100	450		V/mV
r_i	Input resistance				65		MΩ
c_i	Input capacitance				2.5		pF
z_o	Open-loop output impedance	f = 1 MHz			30		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min,	R_S = 50 Ω	80	108		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm}$ = ±2.5 V to ±15 V,	R_S = 50 Ω	85	106		dB
I_{OS}	Short-circuit output current	V_O = 0	V_{ID} = 1 V	–25	–50		mA
			V_{ID} = –1 V	20	31		
I_{CC}	Supply current	V_O = 0,	No load		13.8	18	mA

TYPICAL CHARACTERISTICS

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TYPICAL CHARACTERISTICS

**TLE2141
DISTRIBUTION OF
INPUT OFFSET VOLTAGE**

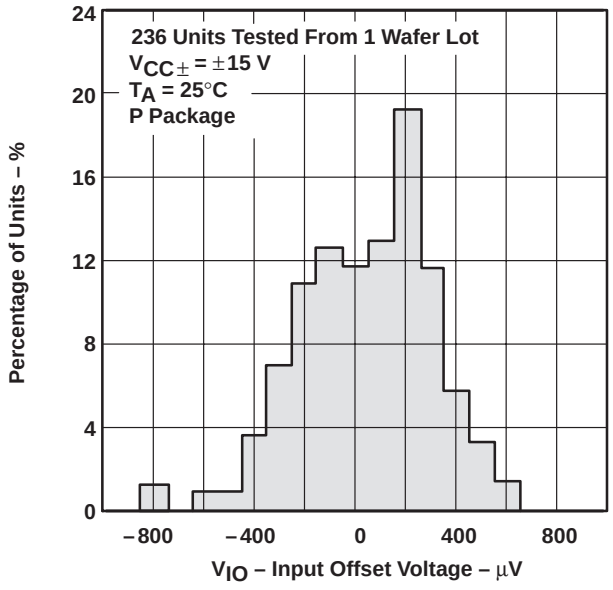


Figure 1

**TLE2142
DISTRIBUTION OF
INPUT OFFSET VOLTAGE**

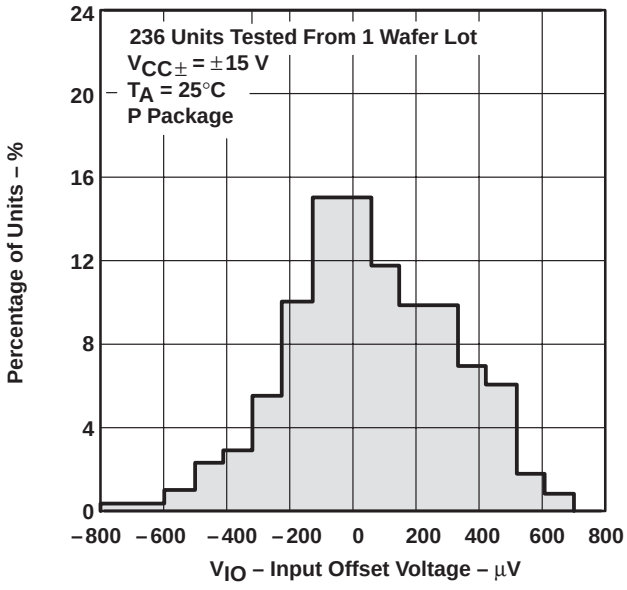


Figure 2

**TLE2144
DISTRIBUTION OF
INPUT OFFSET VOLTAGE**

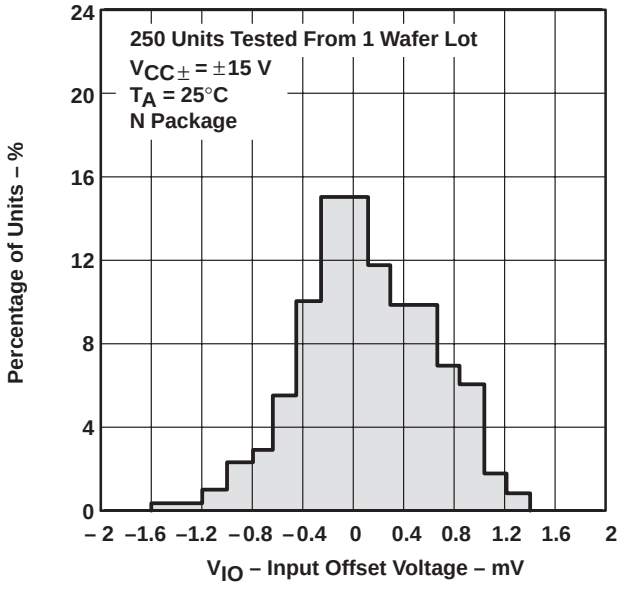


Figure 3

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

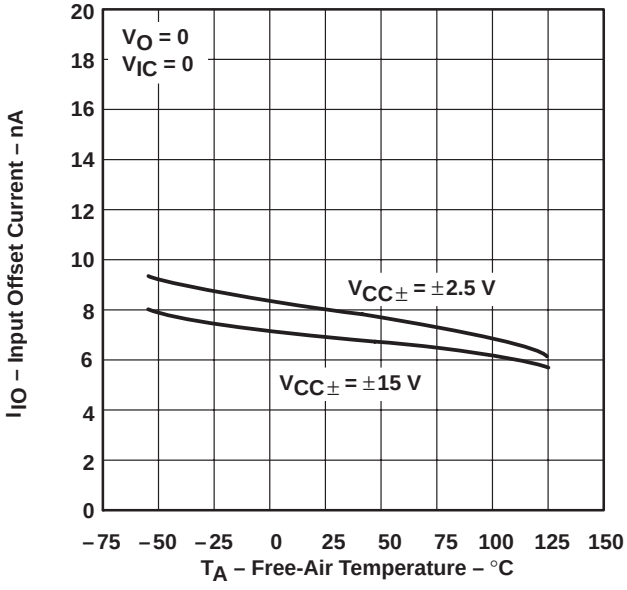


Figure 4

† 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 COMMON-MODE INPUT VOLTAGE

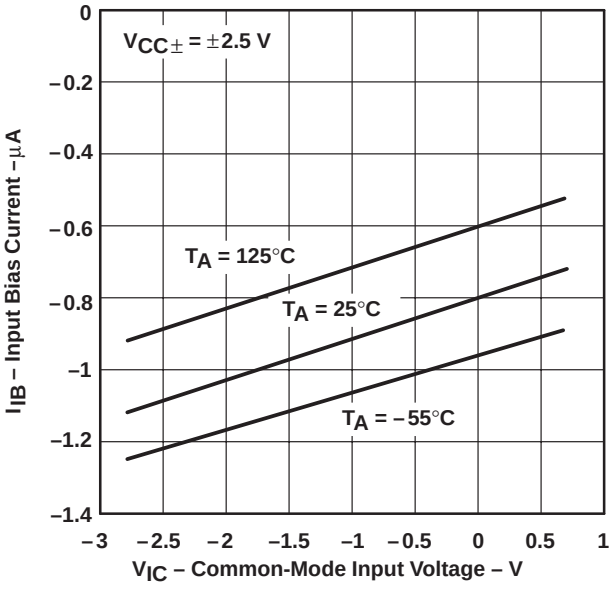


Figure 5

INPUT BIAS CURRENT† vs FREE-AIR TEMPERATURE

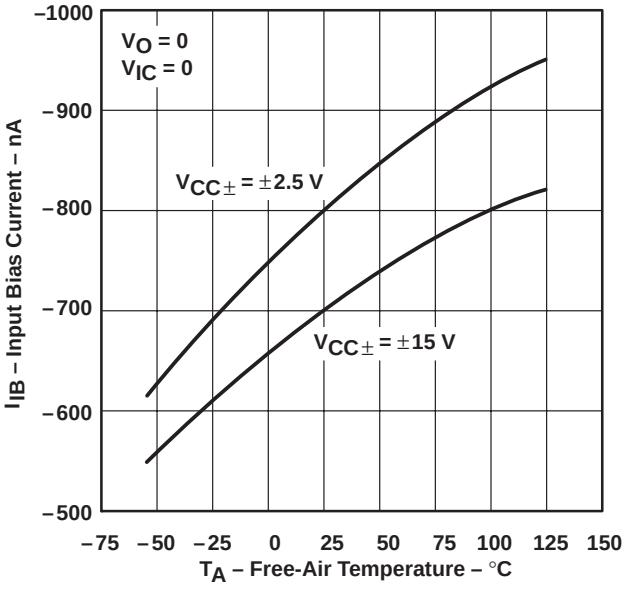


Figure 6

MAXIMUM PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE

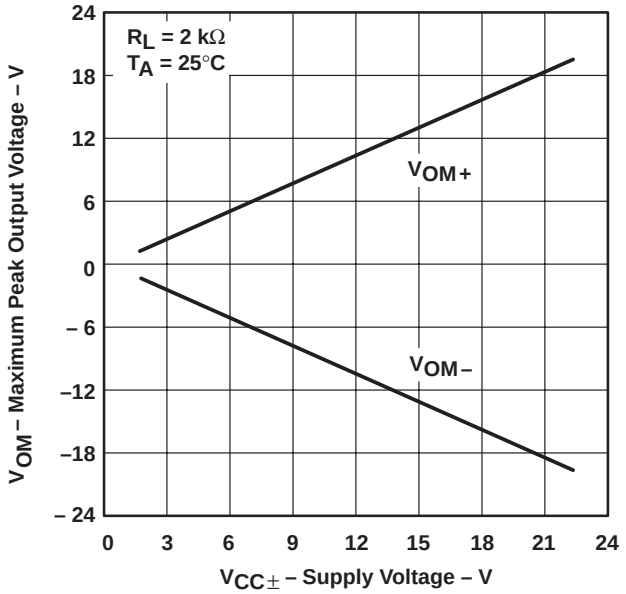


Figure 7

MAXIMUM PEAK OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE

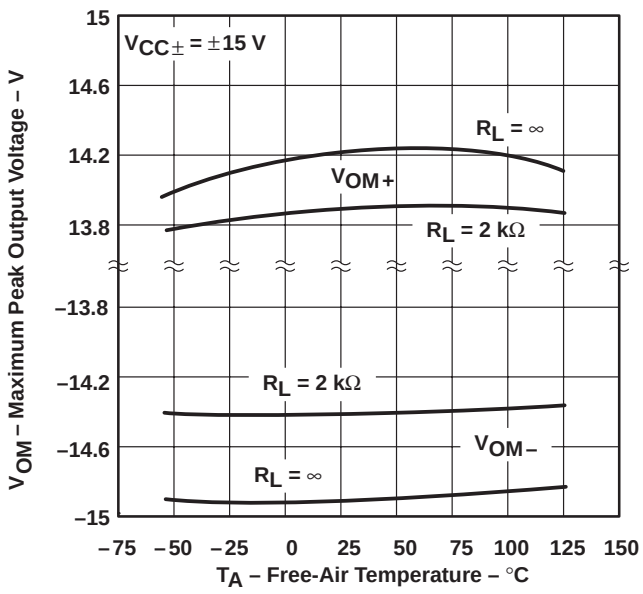


Figure 8

† 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

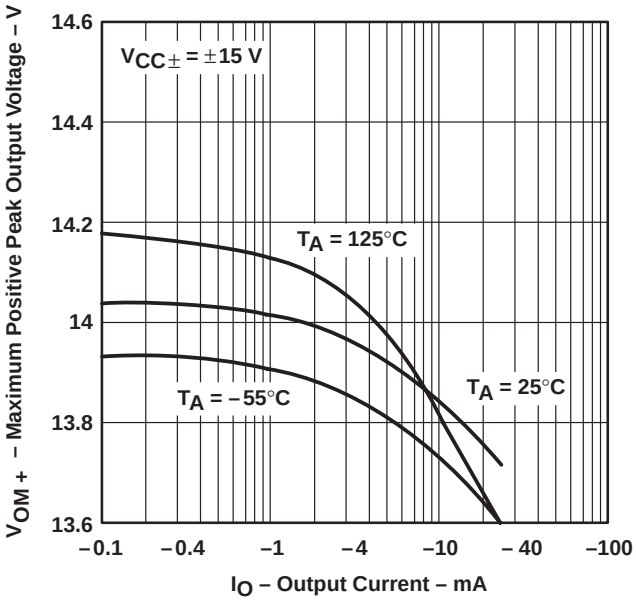


Figure 9

MAXIMUM NEGATIVE PEAK OUTPUT VOLTAGE† vs OUTPUT CURRENT

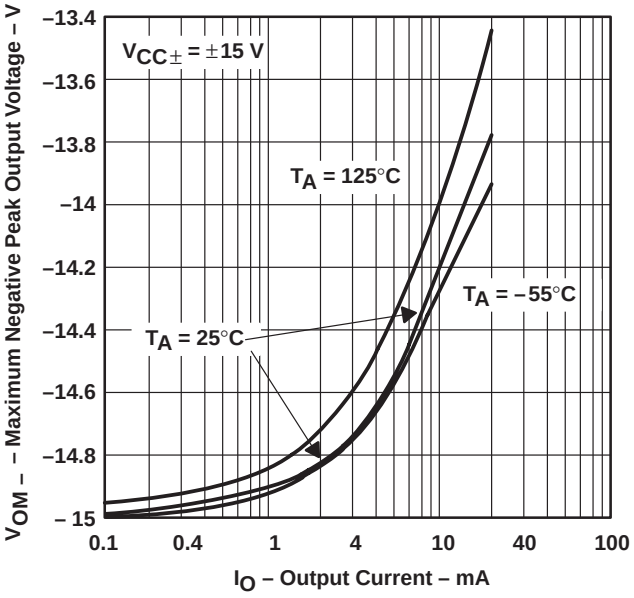


Figure 10

MAXIMUM PEAK OUTPUT VOLTAGE vs SETTLING TIME

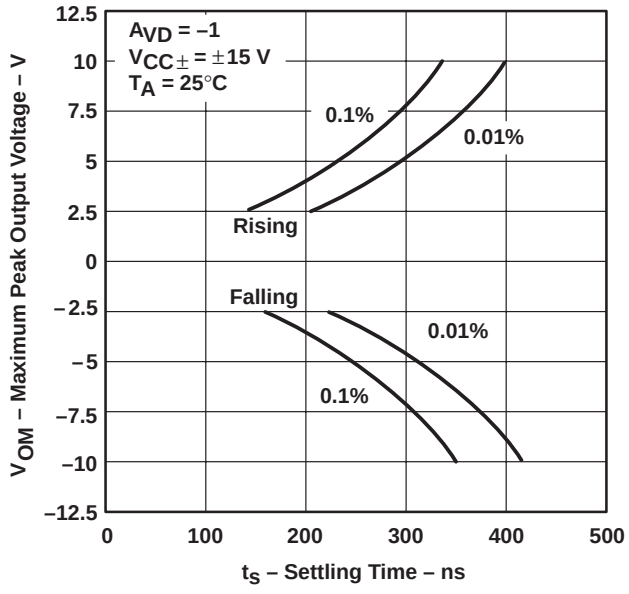


Figure 11

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE† vs FREQUENCY

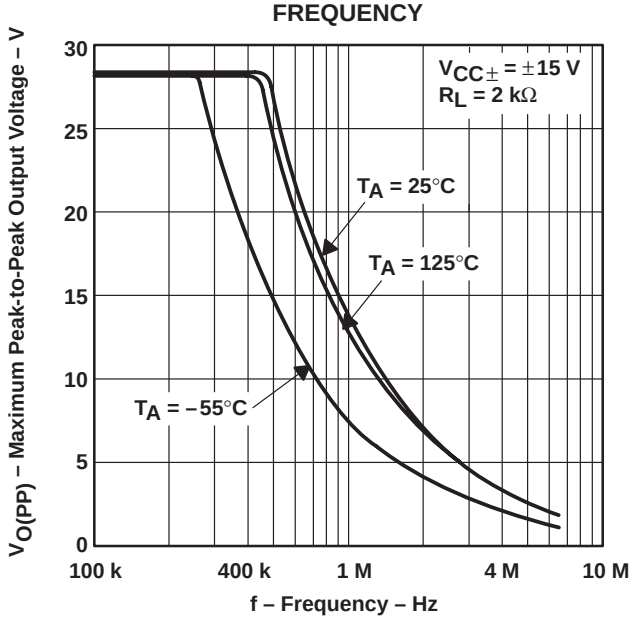


Figure 12

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

TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE† vs OUTPUT CURRENT

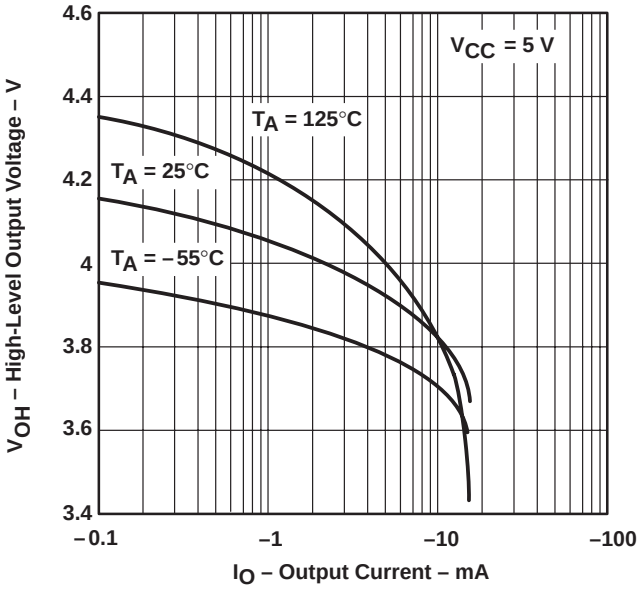


Figure 13

LOW-LEVEL OUTPUT VOLTAGE† vs OUTPUT CURRENT

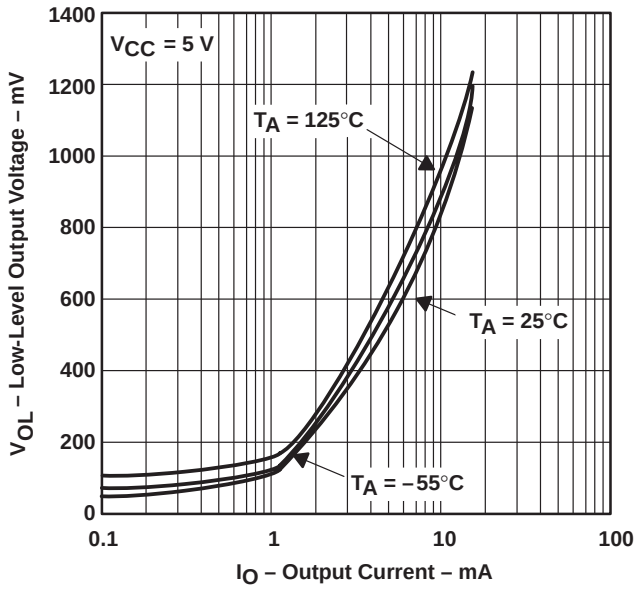


Figure 14

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT vs FREQUENCY

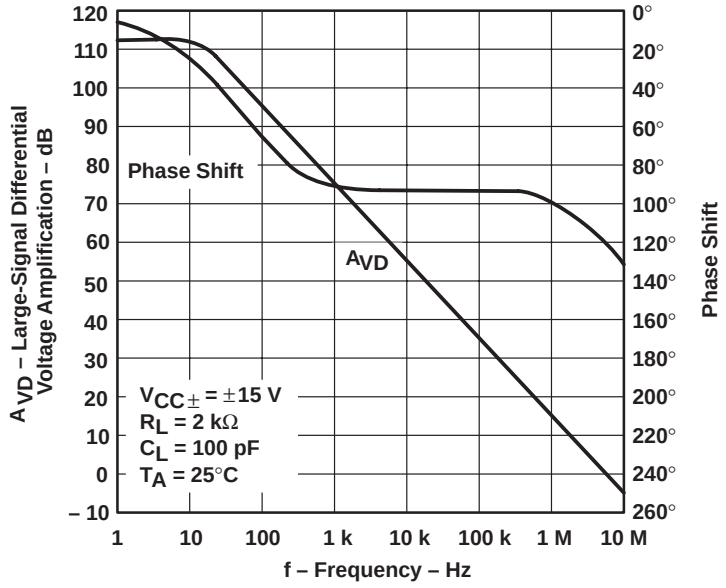


Figure 15

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

TYPICAL CHARACTERISTICS

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

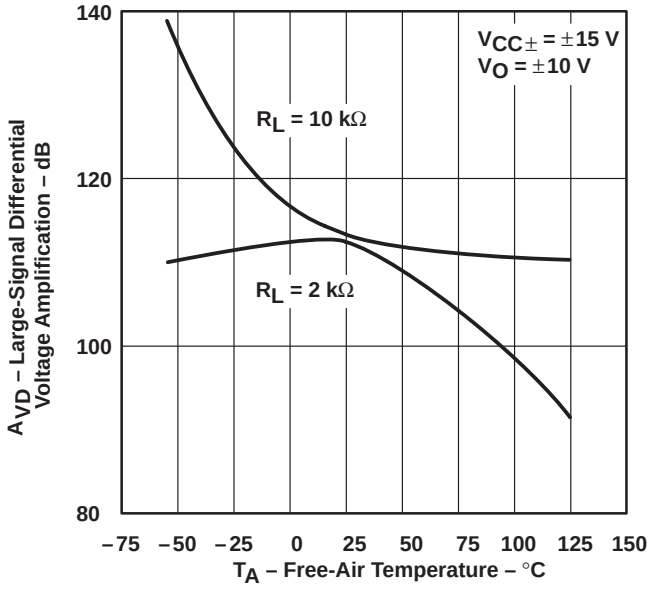


Figure 16

CLOSED-LOOP OUTPUT IMPEDANCE vs FREQUENCY

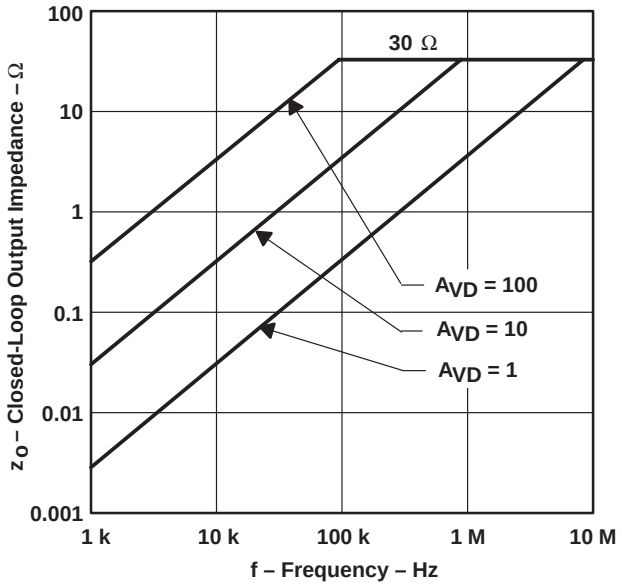


Figure 17

SHORT-CIRCUIT OUTPUT CURRENT† vs FREE-AIR TEMPERATURE

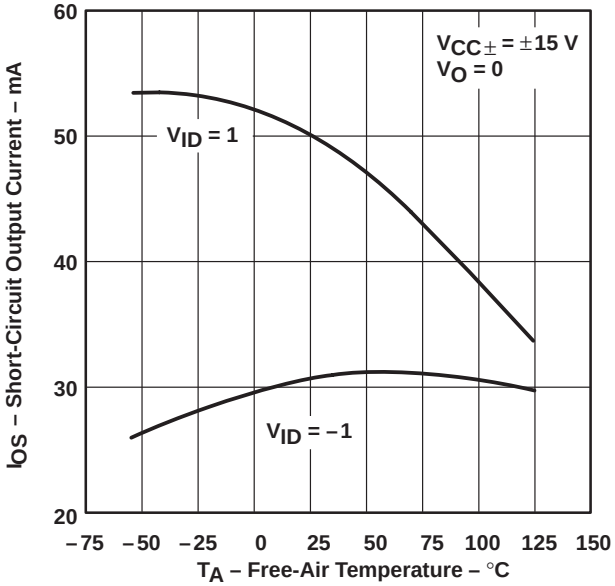


Figure 18

† 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

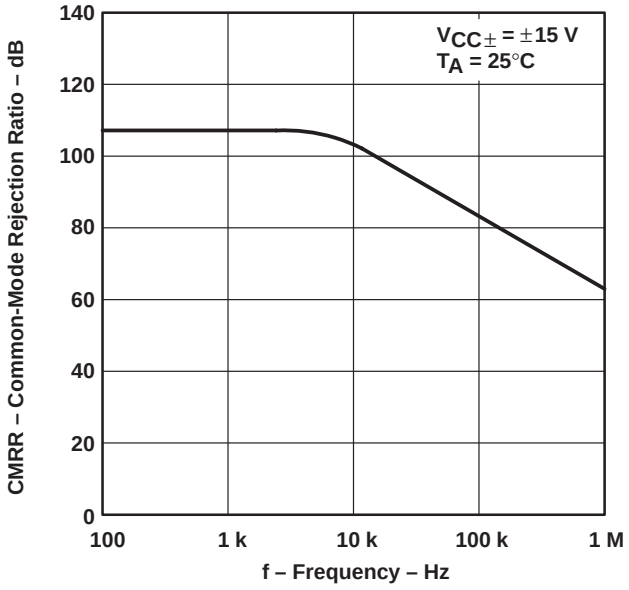


Figure 19

COMMON-MODE REJECTION RATIO† vs FREE-AIR TEMPERATURE

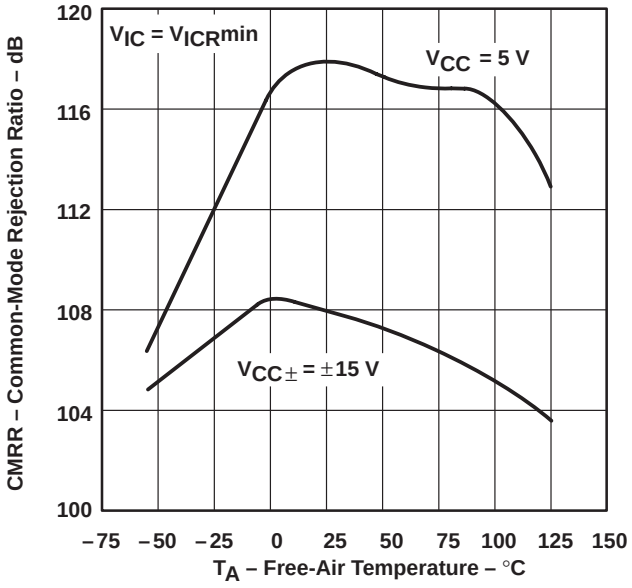


Figure 20

SUPPLY-VOLTAGE REJECTION RATIO vs FREQUENCY

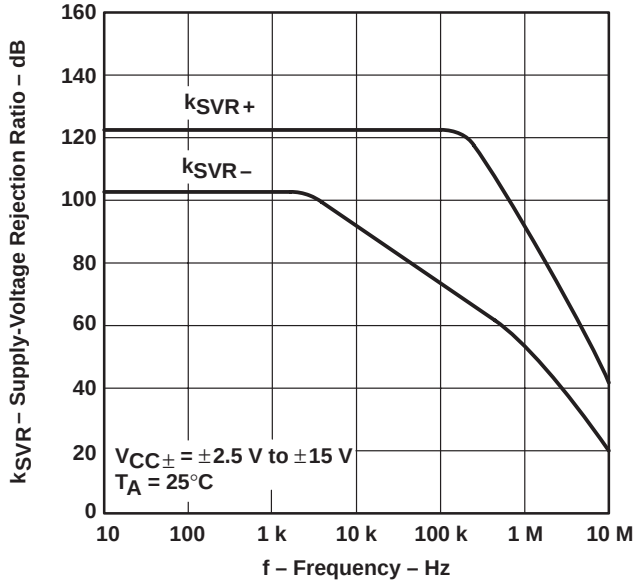


Figure 21

SUPPLY-VOLTAGE REJECTION RATIO† vs FREE-AIR TEMPERATURE

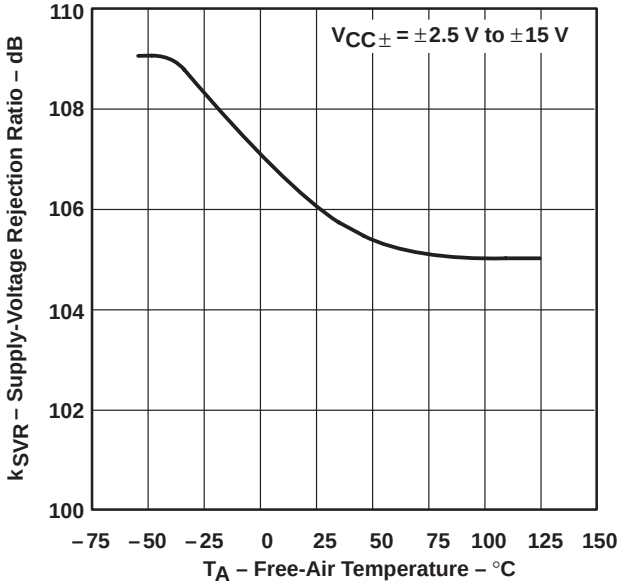


Figure 22

† 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

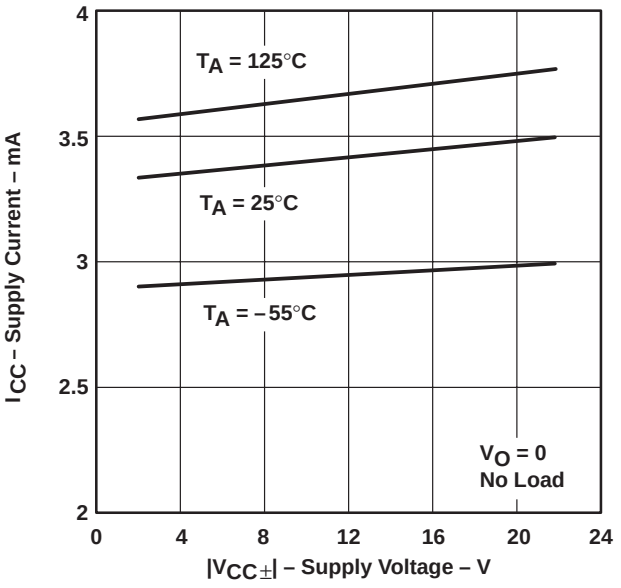


Figure 23

SUPPLY CURRENT† vs FREE-AIR TEMPERATURE

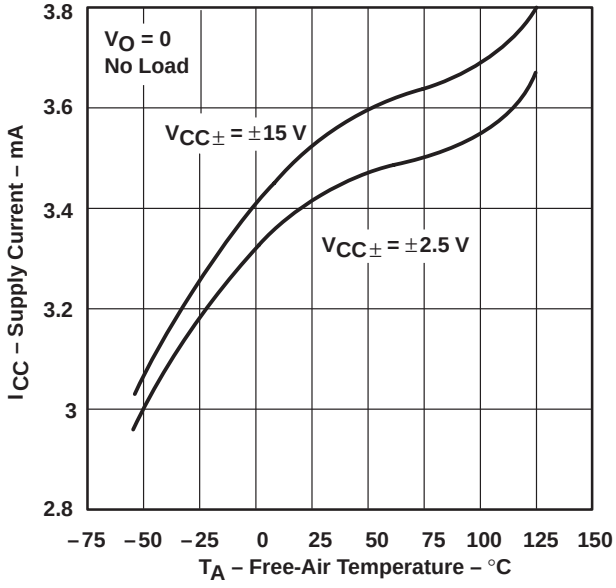


Figure 24

EQUIVALENT INPUT NOISE VOLTAGE† vs FREQUENCY

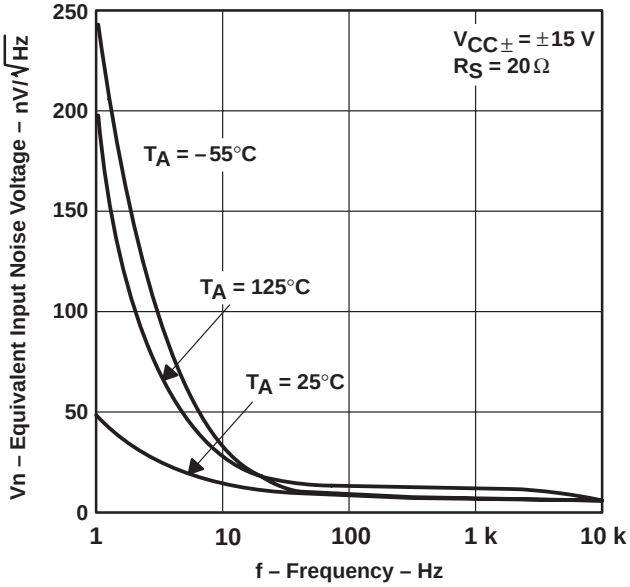


Figure 25

INPUT NOISE VOLTAGE OVER A 10-SECOND PERIOD

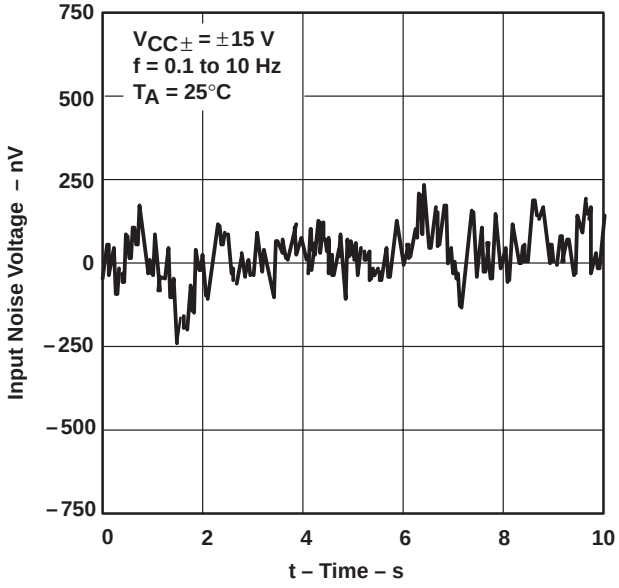


Figure 26

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

TYPICAL CHARACTERISTICS

NOISE CURRENT† vs FREQUENCY

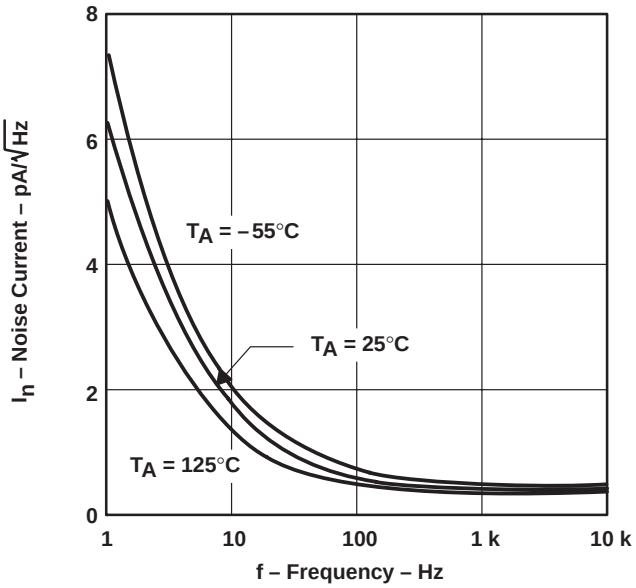


Figure 27

TOTAL HARMONIC DISTORTION PLUS NOISE vs FREQUENCY

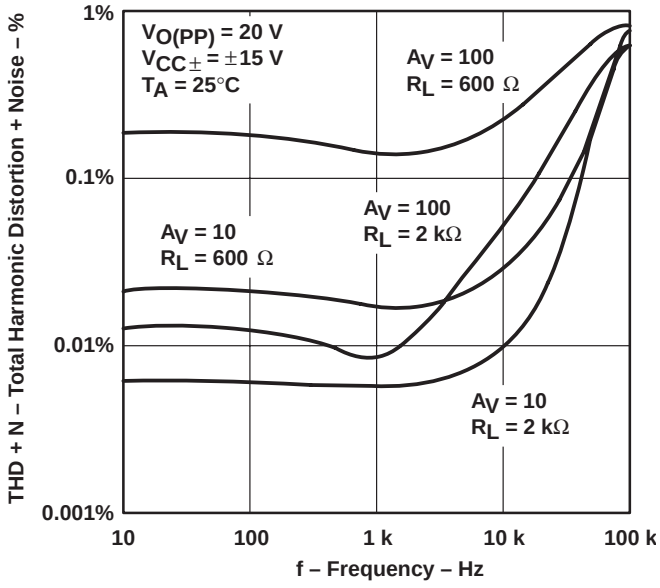


Figure 28

SLEW RATE† vs FREE-AIR TEMPERATURE

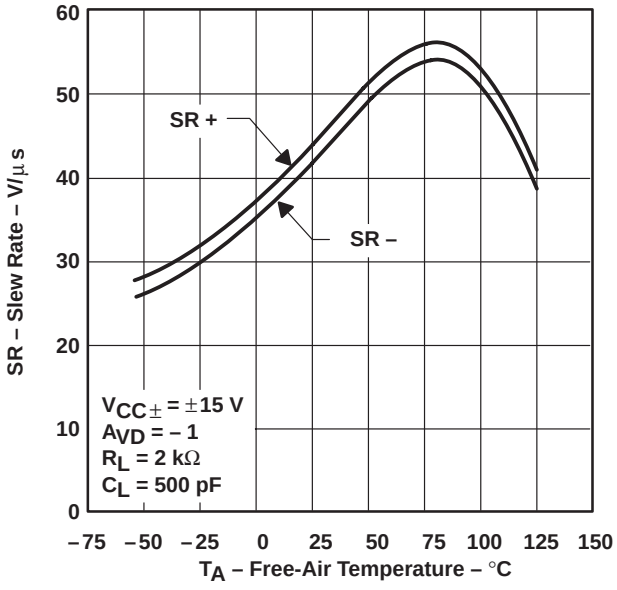


Figure 29

SLEW RATE vs LOAD CAPACITANCE

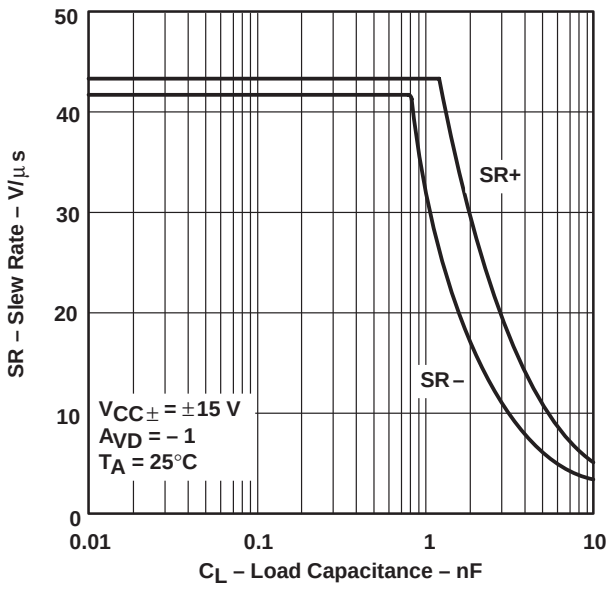


Figure 30

† 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†

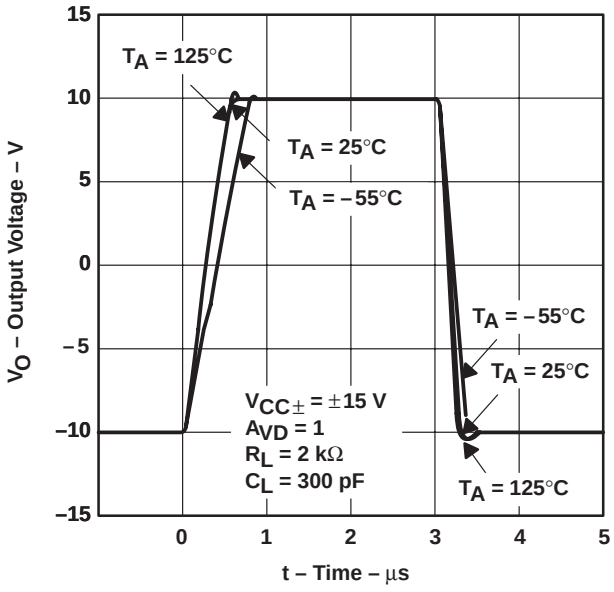


Figure 31

INVERTING LARGE-SIGNAL PULSE RESPONSE†

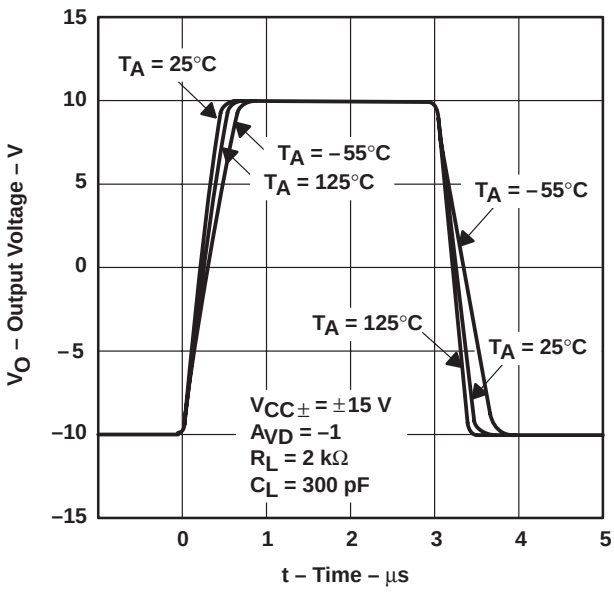


Figure 32

SMALL-SIGNAL PULSE RESPONSE

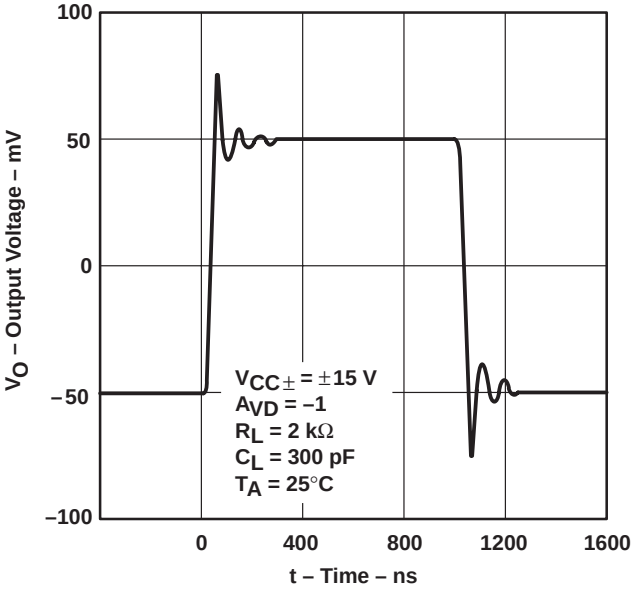


Figure 33

UNITY-GAIN BANDWIDTH† vs LOAD CAPACITANCE

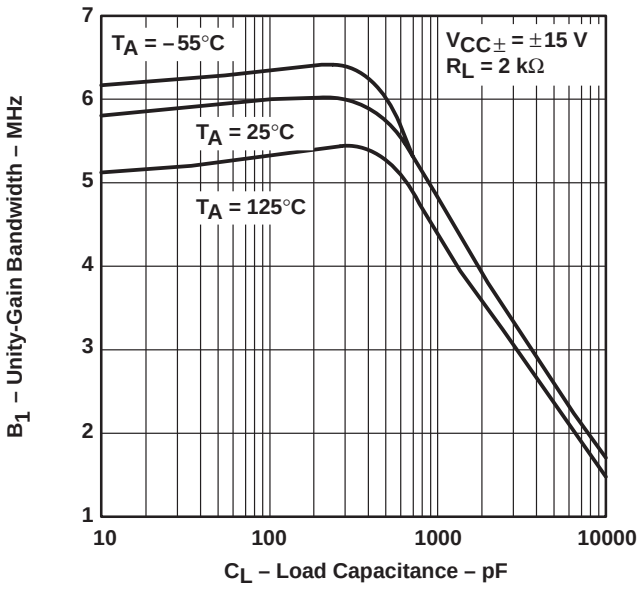


Figure 34

† 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

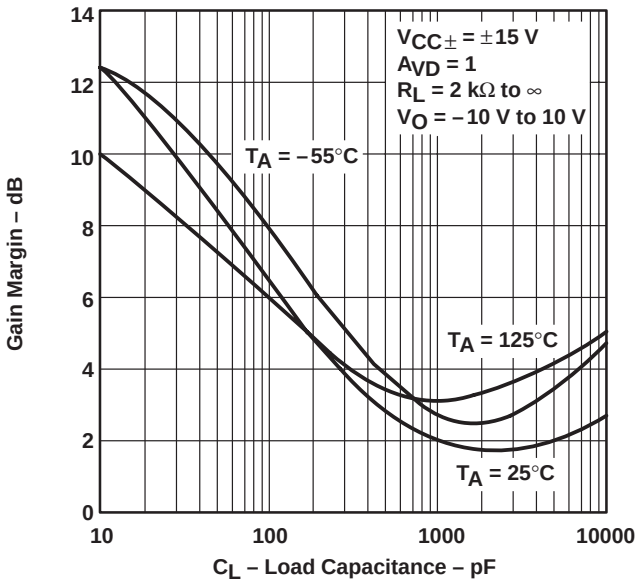


Figure 35

PHASE MARGIN† vs LOAD CAPACITANCE

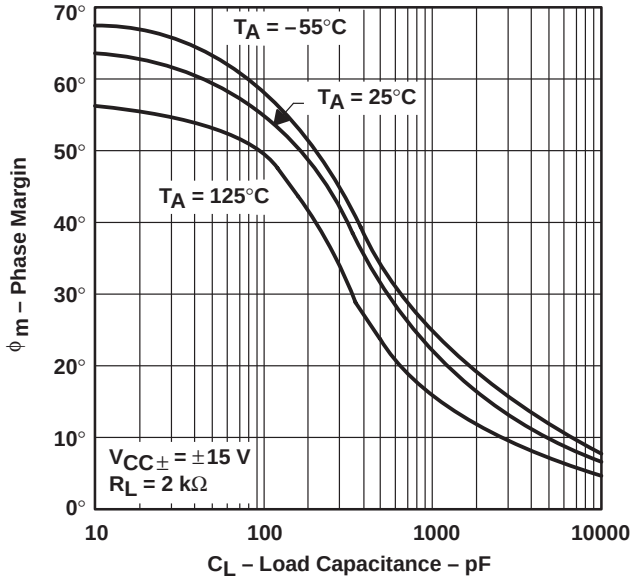


Figure 36

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

APPLICATION INFORMATION

input offset voltage nulling

The TLE2141 series offers external null pins that can be used to further reduce the input offset voltage. If this feature is desired, connect the circuit of Figure 37 as shown. If external nulling is not needed, the null pins may be left unconnected.

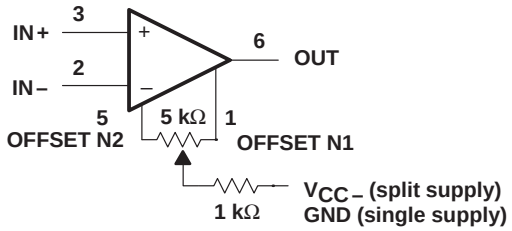
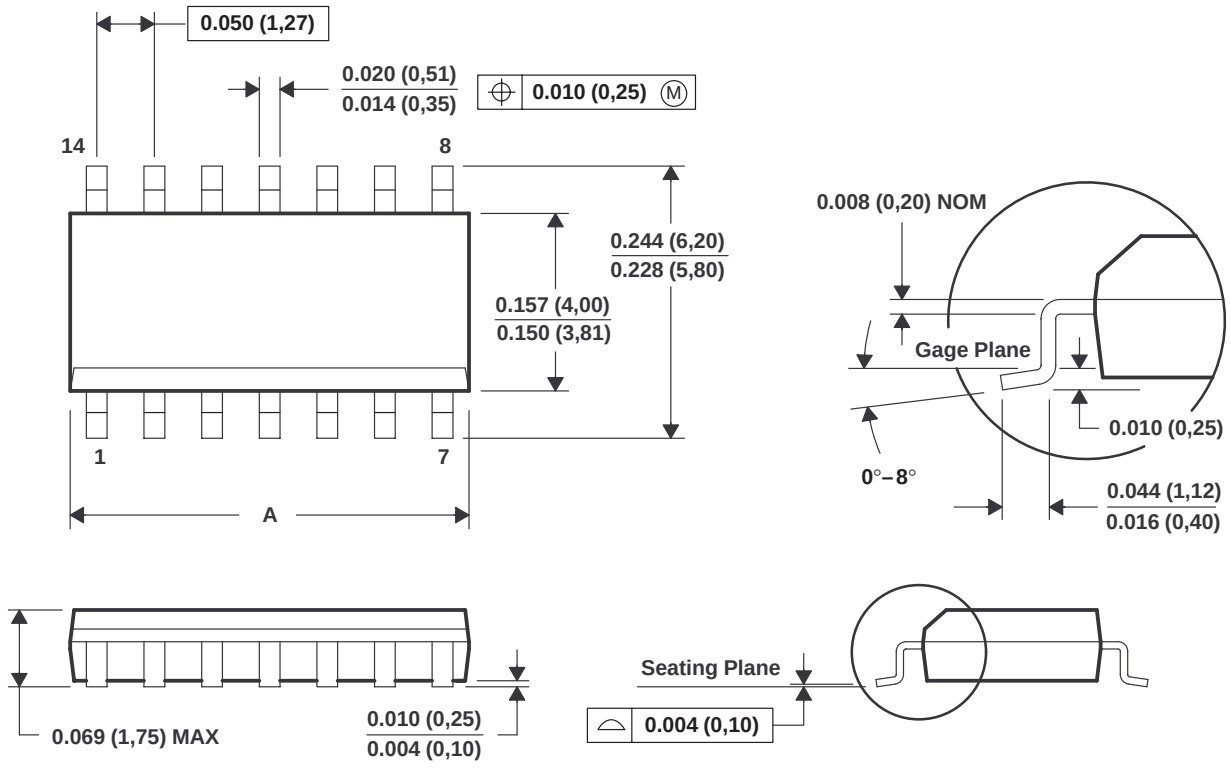


Figure 37. Input Offset Voltage Null Circuit

MECHANICAL INFORMATION

D (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

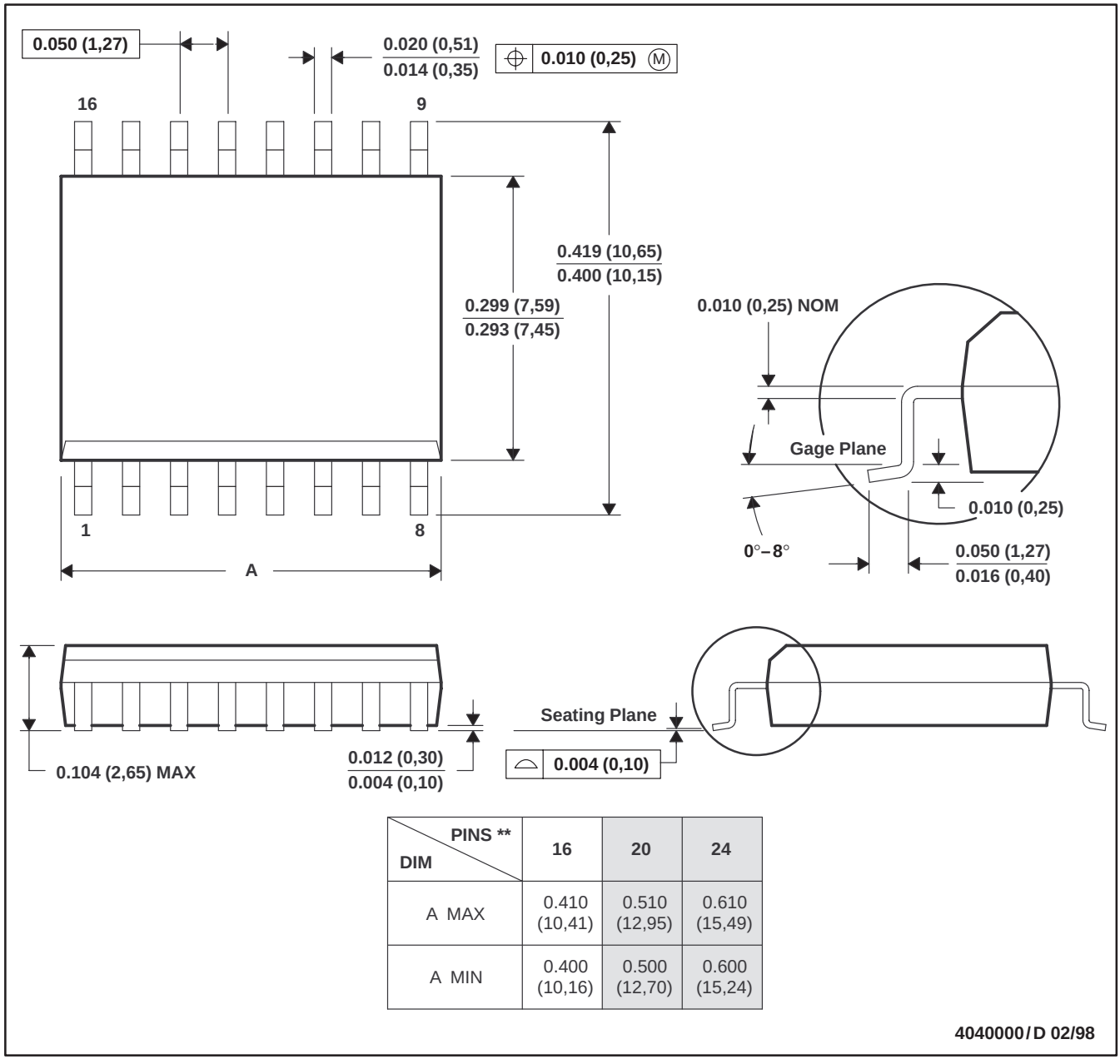
4040047/D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

MECHANICAL INFORMATION

DW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

16 PIN SHOWN



DIM \ PINS **	16	20	24
A MAX	0.410 (10,41)	0.510 (12,95)	0.610 (15,49)
A MIN	0.400 (10,16)	0.500 (12,70)	0.600 (15,24)

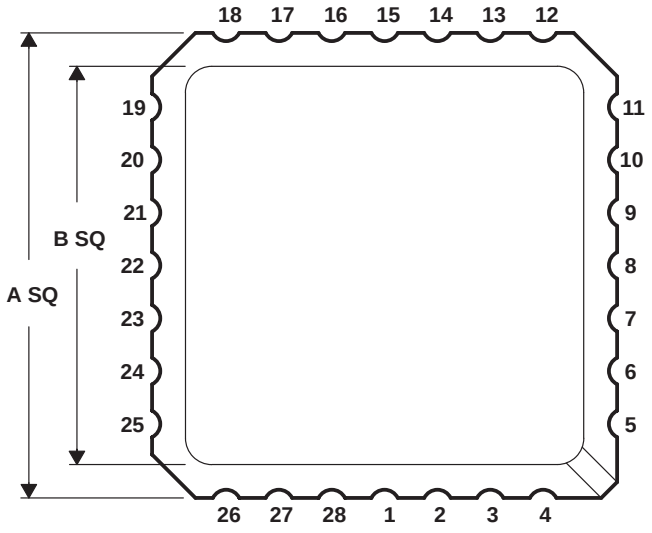
4040000/D 02/98

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-013

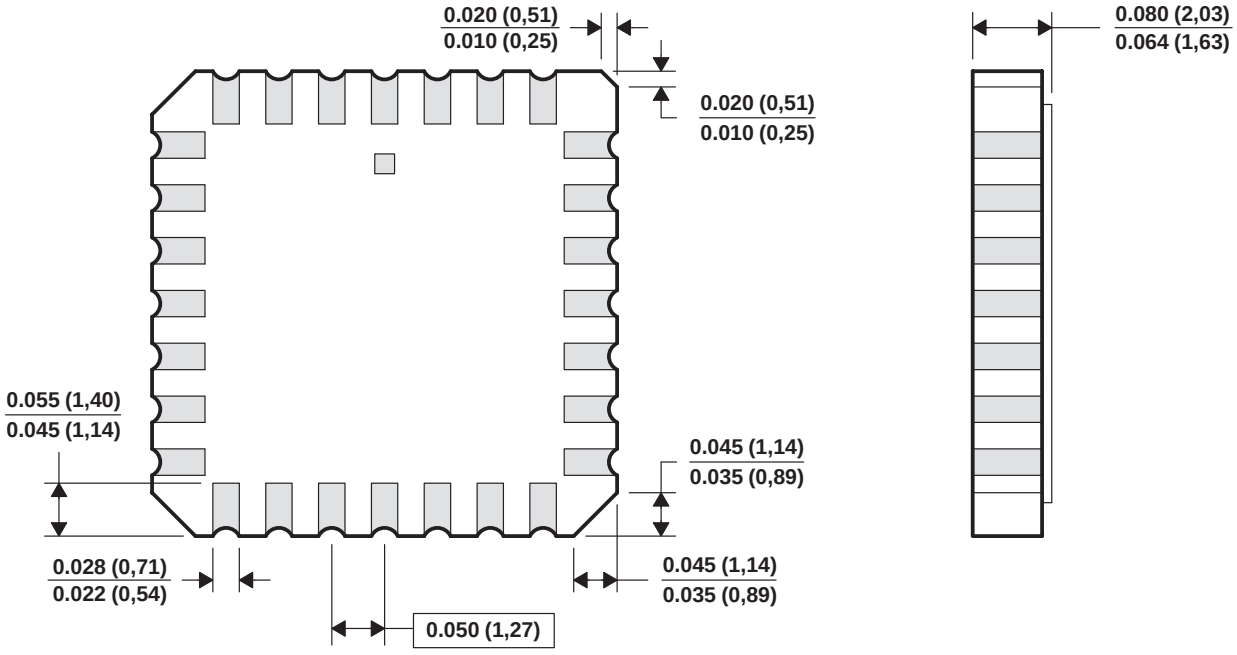
MECHANICAL INFORMATION

FK (S-CQCC-N)** **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



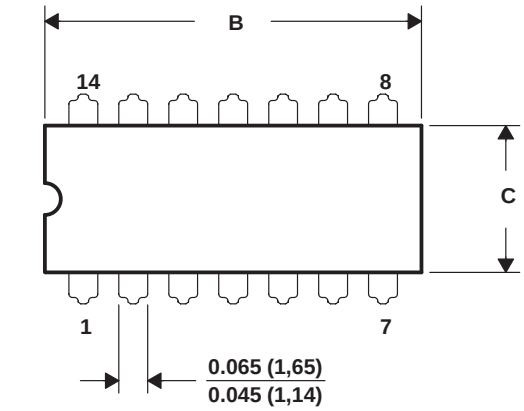
4040140/D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

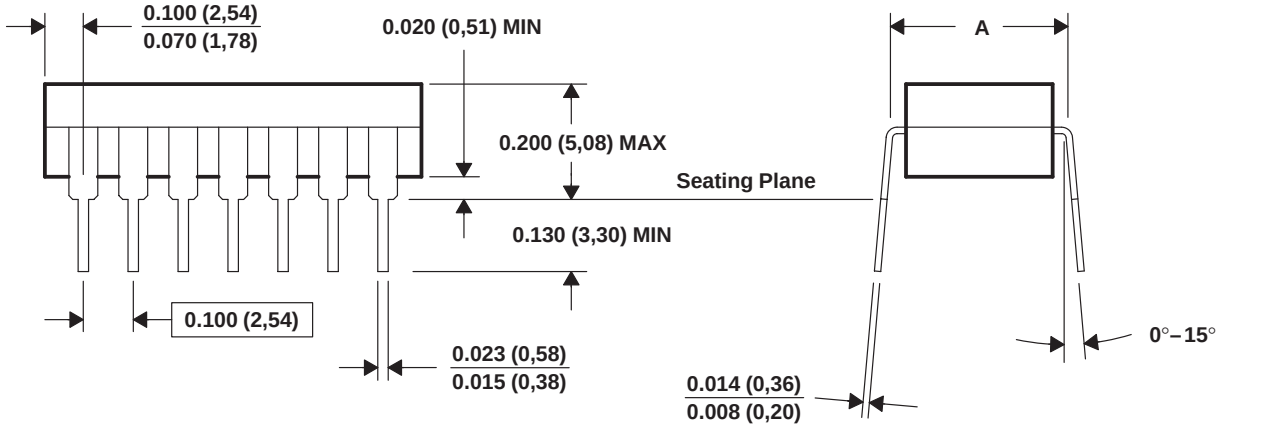
MECHANICAL INFORMATION

J (R-GDIP-T)** **CERAMIC DUAL-IN-LINE PACKAGE**

14 PIN SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.310 (7,87)	0.310 (7,87)	0.310 (7,87)	0.310 (7,87)
A MIN	0.290 (7,37)	0.290 (7,37)	0.290 (7,37)	0.290 (7,37)
B MAX	0.785 (19,94)	0.785 (19,94)	0.910 (23,10)	0.975 (24,77)
B MIN	0.755 (19,18)	0.755 (19,18)	—	0.930 (23,62)
C MAX	0.280 (7,11)	0.300 (7,62)	0.300 (7,62)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.245 (6,22)	0.245 (6,22)

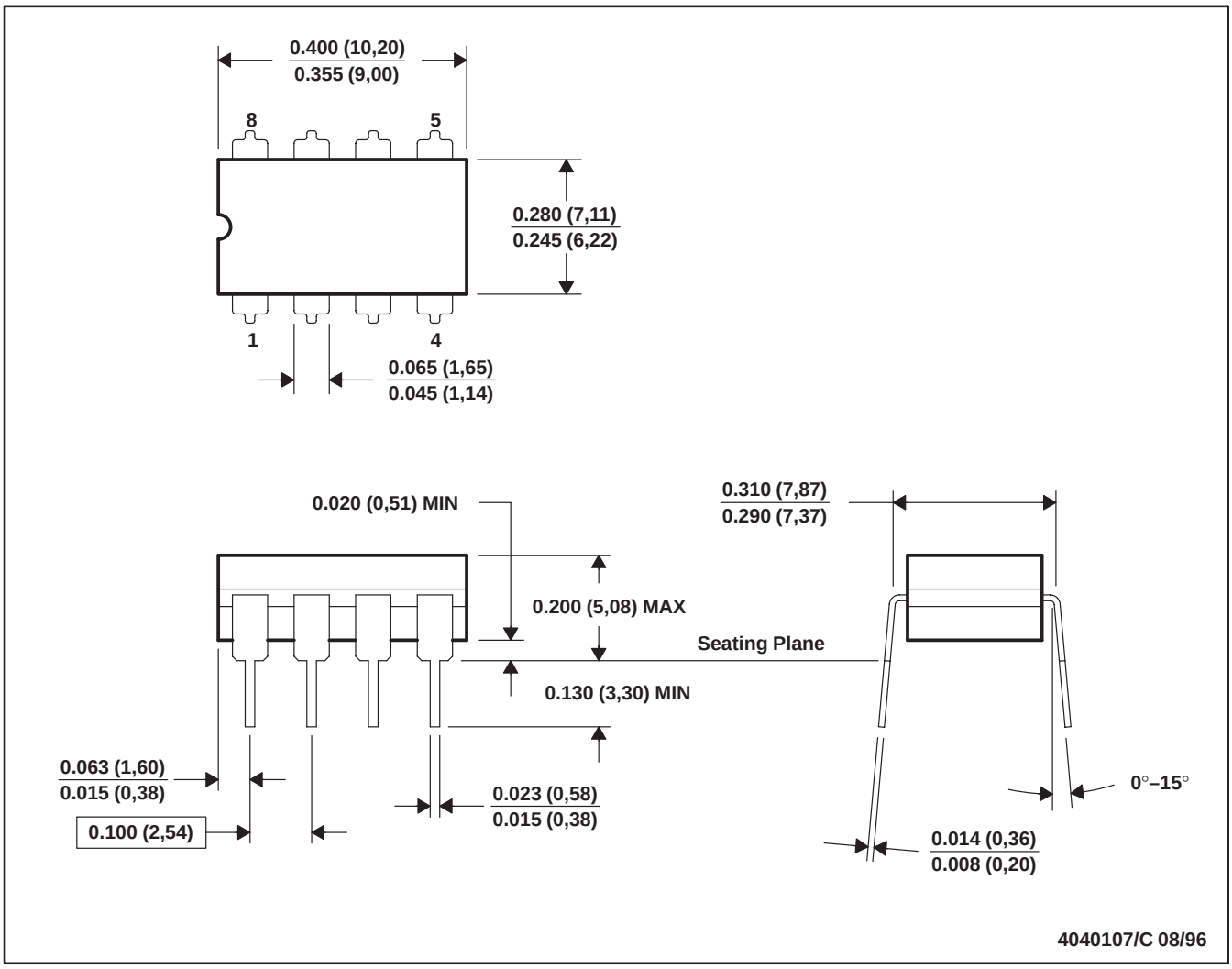


4040083/C 08/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL-STD-1835 GDIP1-T14, GDIP1-T16, GDIP1-T18, and GDIP1-T20

MECHANICAL INFORMATION

JG (R-GDIP-T8) **CERAMIC DUAL-IN-LINE PACKAGE**



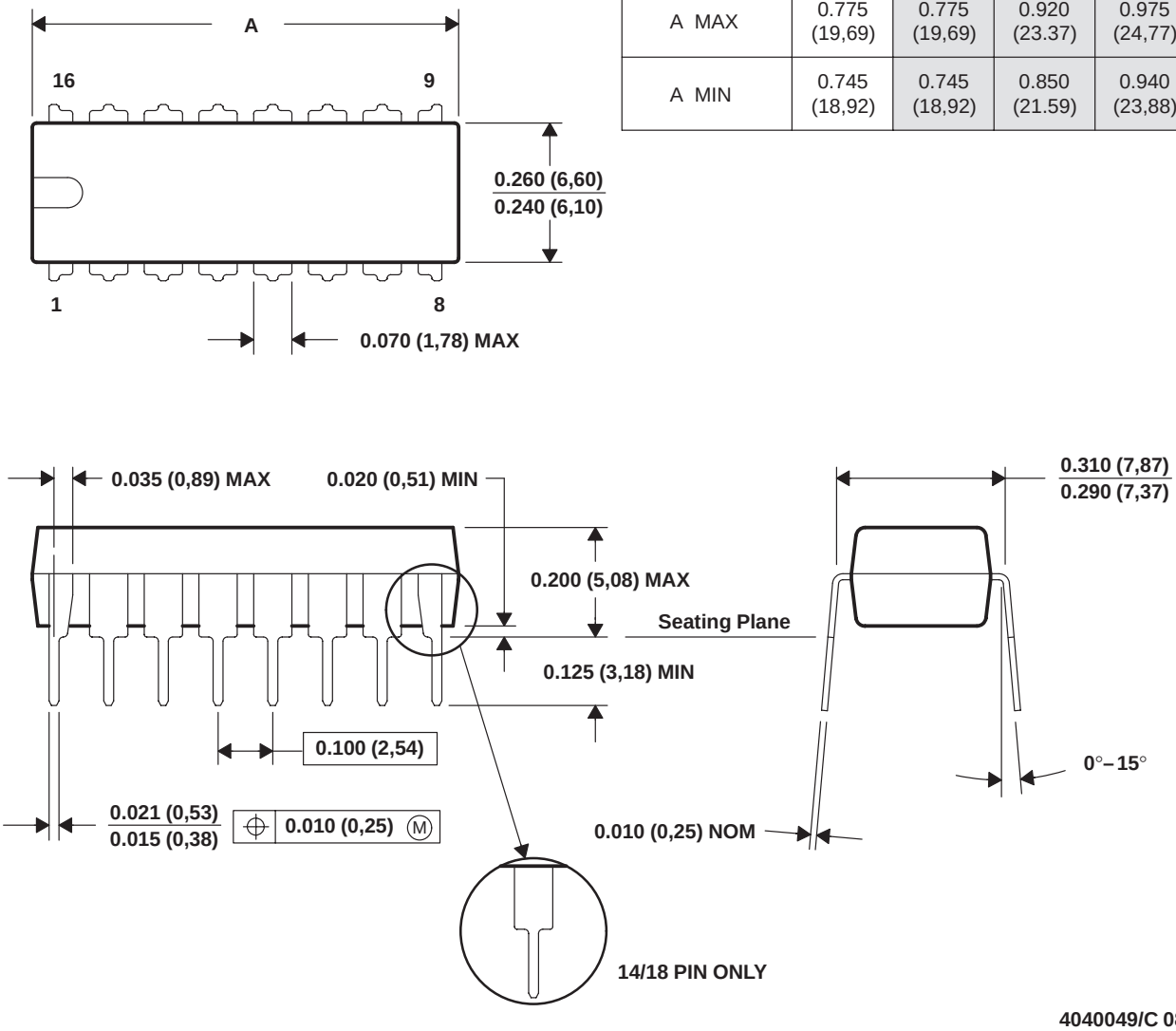
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL-STD-1835 GDIP1-T8

MECHANICAL INFORMATION

N (R-PDIP-T)** **PLASTIC DUAL-IN-LINE PACKAGE**

16 PIN SHOWN

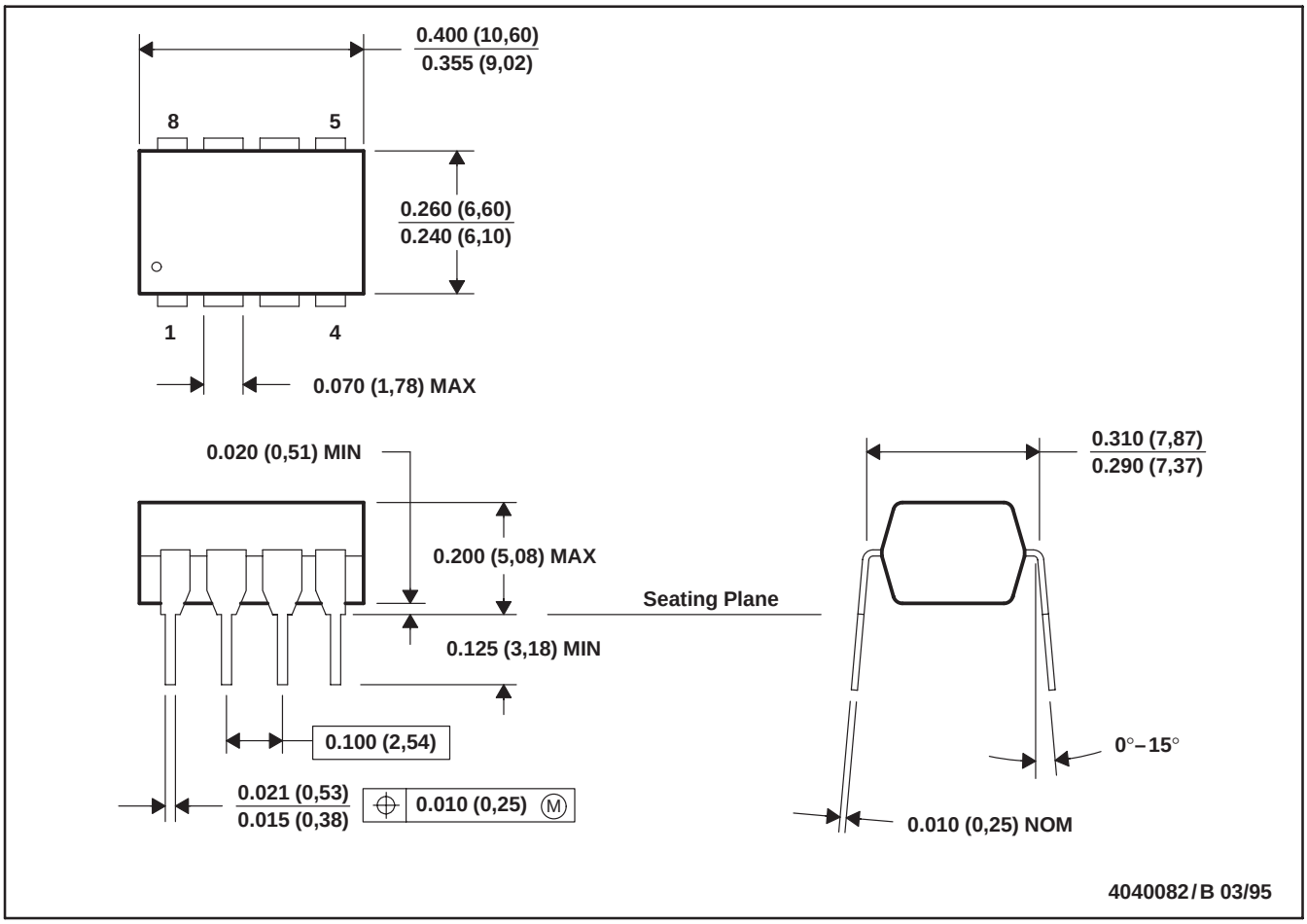
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23.37)	0.975 (24,77)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21.59)	0.940 (23,88)



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001 (20 pin package is shorter then MS-001.)

MECHANICAL INFORMATION

P (R-PDIP-T8) **PLASTIC DUAL-IN-LINE PACKAGE**

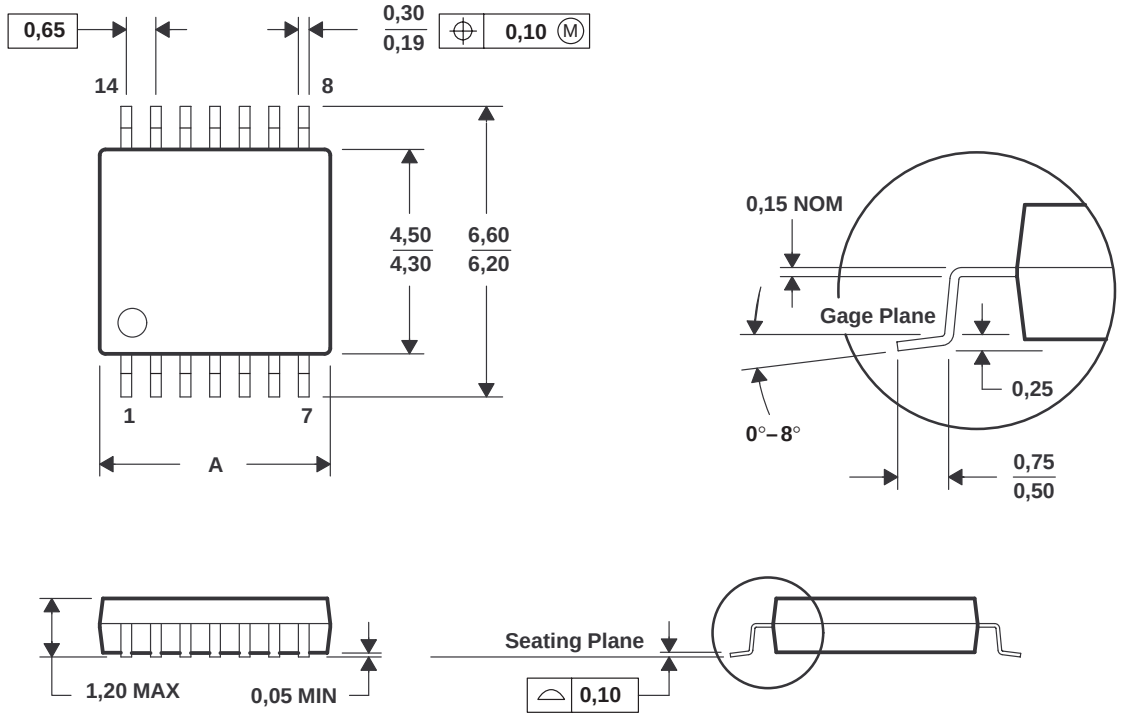


NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

MECHANICAL INFORMATION

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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