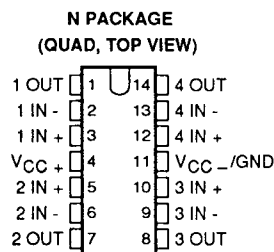
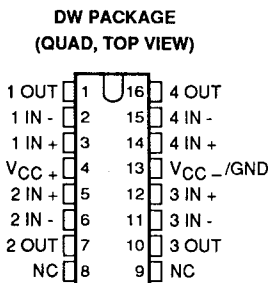
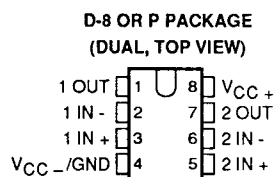
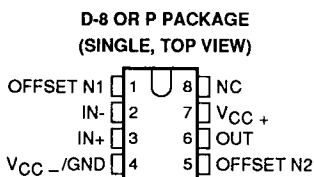


# TL33071, TL33072, TL33074, TL34071, TL34072, TL34074 TL35071, TL35072, TL35074 HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIERS

D3825, MARCH 1991 – REVISED JULY 1991

## available features

- Wide Gain-Bandwidth Product . . . 4.5 MHz
- High Slew Rate . . . 13 V/ $\mu$ s
- Fast Settling Time . . . 1.1  $\mu$ s to 0.1 %
- Wide-Range Single-Supply Operation  
4 V to 44 V
- Wide Input Common-Mode Range  
Includes Ground ( $V_{CC-}$ )
- Low Total Harmonic Distortion . . . 0.02 %
- Low Input Offset Voltage . . . 3 mV Max  
(A Suffix)
- Large Output Voltage Swing  
– 14.7 V to 14 V (With  $\pm 15$ -V Supplies)
- Large Capacitance Drive Capability  
0 to 10,000 pF
- Excellent Phase Margin . . . 60°
- Excellent Gain Margin . . . 12 dB
- Output Short-Circuit Protection



NC – No internal connection

## AVAILABLE OPTIONS

T <sub>A</sub>	COMPLEXITY	PACKAGE			
		PLASTIC DIP		SMALL OUTLINE	
		STANDARD GRADE	PRIME GRADE	STANDARD GRADE	PRIME GRADE
0°C to 70°C	Single	TL34071P	TL34071AP	TL34071D	TL34071AD
	Dual	TL34072P	TL34072AP	TL34072D	TL34072AD
	Quad	TL34074N	TL34074AN	TL34074DW	TL34074ADW
– 40°C to 105°C	Single	TL33071P	TL33071AP	TL33071D	TL33071AD
	Dual	TL33072P	TL33072AP	TL33072D	TL33072AD
	Quad	TL33074N	TL33074AN	TL33074DW	TL33074ADW
– 55°C to 125°C	Single	TL35071P	TL35071AP	TL35071D	TL35071AD
	Dual	TL35072P	TL35072AP	TL35072D	TL35072AD
	Quad	TL35074N	TL35074AN	TL35074DW	TL35074ADW

D packages are available taped and reeled. Add "R" suffix to device type (e.g., TL34071ADR).

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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# TL33071, TL33072, TL33074, TL34071, TL34072, TL34074 TL35071, TL35072, TL35074 HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIERS

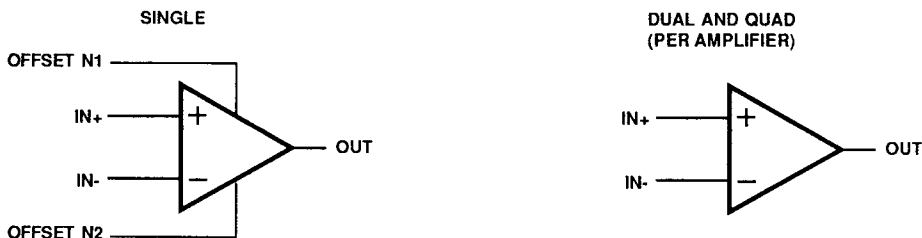
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## description

Quality, low cost, bipolar fabrication with innovative design concepts are employed for the TL33071/2/4, TL34071/2/4, and TL35071/2/4 series of monolithic operational amplifiers. This series of operational amplifiers offer 4.5 MHz of gain bandwidth product, 13 V/ $\mu$ s slew rate and fast settling time without the use of JFET device technology. Although this series can be operated from split supplies, it is particularly suited for single-supply operation, since the common-mode input voltage range includes ground potential ( $V_{CC-}$ ). With a Darlington input stage, this series exhibits high input resistance, low input offset voltage, and high gain. The all-NPN output stage, characterized by no dead-band crossover distortion and large output voltage swing, provides high-capacitance drive capability, excellent phase and gain margins, low open-loop high-frequency output impedance, and symmetrical source/sink ac frequency response.

The TL33071/2/4, TL34071/1/4, and TL35071/2/4 series of devices are available in standard or prime performance (A-Suffix) grades and are specified over the commercial (0°C to 70°C), industrial/vehicular (-40°C to 105°C) or military (-55°C to 125°C) temperature ranges. These low-cost amplifiers are available in single, dual and quad configurations and are pin-compatible with the (low-cost) MC33071/2/4, MC34071/2/4, and MC35071/2/4 series of amplifiers. Packaging options include standard plastic DIP and SO packages.

## symbol



**TL33071, TL33072, TL33074, TL34071, TL34072, TL34074  
TL35071, TL35072, TL35074  
HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIERS**

**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 (see Note 2)	$\pm 44$ V
Input voltage range, $V_I$ (any input)	$V_{CC\pm}$
Input current, $I_I$ (each input)	$\pm 1$ mA
Output current, $I_O$	$\pm 80$ mA
Total current into $V_{CC+}$ terminal	80 mA
Total current out of $V_{CC-}$ terminal	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, $T_A$ : TL3307_	- 40°C to 105°C
TL3407_	0°C to 70°C
TL3507_	- 55°C to 125°C
Storage temperature range	- 65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, DW, N, or P package	260°C

- NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .  
 2. Differential voltages are at the noninverting input with respect to the inverting input. Excessive current will flow 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	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR	$T_A = 70^\circ\text{C}$	$T_A = 105^\circ\text{C}$	$T_A = 125^\circ\text{C}$
	POWER RATING	ABOVE $T_A = 25^\circ\text{C}$	POWER RATING	POWER RATING	POWER RATING
D-8	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
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

**recommended operating conditions**

		TL3307_		TL3407_		TL3507_		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
Supply voltage, $V_{CC\pm}$		$\pm 2$	$\pm 22$	$\pm 2$	$\pm 22$	$\pm 2$	$\pm 22$	V
Common-mode input voltage, $V_{IC}$	$V_{CC} = 5$ V	0	2.7	0	2.9	0	2.7	V
	$V_{CC\pm} = \pm 15$ V	- 15	12.7	- 15	12.9	- 15	12.7	
Operating free-air temperature, $T_A$		- 40	105	0	70	- 55	125	°C

**TL33071, TL33072, TL33074, TL34071, TL34072, TL34074  
 TL35071, TL35072, TL35074  
 HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIERS**

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

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	A SUFFIX			NON-A SUFFIX			UNIT
			MIN	TYP $^\ddagger$	MAX	MIN	TYP $^\ddagger$	MAX	
$V_{IO}$ Input offset voltage		$V_{CC} = 5V$	25°C	0.5	3	1.5	5	mV	
		$V_{CC} = \pm 15V$	25°C	0.5	3	1.0	5		
$\alpha_{VIO}$ Temperature coefficient of input offset voltage	$V_{IC} = 0,$ $V_O = 0,$ $R_S = 50\ \Omega$	$V_{CC} = \pm 15V$	Full range	10		10		$\mu V/^\circ C$	
$I_{IO}$ Input offset current		$V_{CC} = \pm 15V$	25°C	6	50	6	50	nA	
$I_{IB}$ Input bias current		$V_{CC} = \pm 15V$	Full range	300		300		$\mu A$	
		$V_{CC} = 5V$	25°C	-0.8	-2	-0.8	-2		
$V_{ICR}$ Common-mode input voltage range	$R_S = 50\ \Omega$	$V_{CC} = \pm 15V$	25°C	-15 V to 13.2 V		-15 V to 13.2 V		V	
		$V_{CC} = 5V$	Full range	-15 V to 12.8 V		-15 V to 12.8 V			
$V_{OH}$ High-level output voltage	$V_{CC+} = 5V, V_{CC-} = 0,$ $R_L = 2\ k\Omega$	$V_{CC} = \pm 15V$	25°C	3.7	4	3.7	4	V	
		$V_{CC} = 5V$	25°C	13.6	14	13.6	14		
$V_{OL}$ Low-level output voltage	$V_{CC+} = 5V, V_{CC-} = 0,$ $R_L = 10\ k\Omega$	$V_{CC} = \pm 15V$	25°C	0.1 0.3		0.1 0.3		V	
		$V_{CC} = 5V$	25°C	-14.7 -14.3		-14.7 -14.3			
$A_{VD}$ Large-signal differential voltage amplification	$V_O = \pm 10V, R_L = 2\ k\Omega$	$V_{CC} = \pm 15V$	25°C	50	100	25	100	V/mV	
		$V_{CC} = 5V$	Full range	25		20			
$I_{OS}$ Short-circuit output current	Source: $V_{ID} = 1V, V_O = 0$ Sink: $V_{ID} = -1V, V_O = 0$	$V_{CC} = \pm 15V$	25°C	-10	-30	-10	-30	mA	
		$V_{CC} = 5V$	25°C	20	30	20	30		
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR\ min},$ $R_S = 50\ \Omega$	$V_{CC} = \pm 15V$	25°C	80	97	70	97	dB	
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	$V_{CC\pm} = \pm 13.5V$ to $\pm 16.5V, R_S = 100\ \Omega$	$V_{CC} = \pm 15V$	25°C	80	97	70	97	dB	
$I_{CC}$ Supply current (per channel)	$V_O = 0,$ No Load	$V_{CC} = \pm 15V$	25°C	3.5	4.5	3.5	4.5	mA	
		$V_{CC} = 5V$	Full range	4.7		4.7			
	$V_{CC+} = 5V, V_{CC-} = 0,$ $V_O = 0,$ No Load	$V_{CC} = \pm 15V$	25°C	3.4	4.4	3.4	4.4	mA	
		$V_{CC} = 5V$	Full range	4.6		4.6			

$^\dagger$  Full range is 0°C to 70°C for the TL3407\_ devices, -40°C to 105°C for the TL3307\_ devices, and -55°C to 125°C for the TL3507\_ devices.  
 $^\ddagger$  All typical values are at  $T_A = 25^\circ C$ .

TL33071, TL33072, TL33074, TL34071, TL34072, TL34074  
 TL35071, TL35072, TL35074  
 HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIERS

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

PARAMETER	TEST CONDITIONS	A SUFFIX			NON-A SUFFIX			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
SR +	Positive slew rate	$V_I = -10 \text{ V}$ to		$A_V = 1$	8	10		V/ $\mu\text{s}$
SR -	Negative slew rate	10 V, $R_L = 2 \text{ k}\Omega$		$A_V = -1$		13		
	Settling time	$A_{VD} = -1$ , 10-V Step		To 0.1%		1.1		$\mu\text{s}$
				To 0.01%		2.2		
$V_n$	Equivalent input noise voltage	$f = 1 \text{ kHz}$ , $R_S = 100 \Omega$				32		$\text{nV}/\sqrt{\text{Hz}}$
$I_n$	Equivalent input noise current	$f = 1 \text{ kHz}$				0.22		$\text{pA}/\sqrt{\text{Hz}}$
THD	Total harmonic distortion	$V_O = 2 \text{ V}$ to 20 V, $R_L = 2 \text{ k}\Omega$ , $A_{VD} = 10$ , $f = 10 \text{ kHz}$				0.02		%
GBW	Gain-bandwidth product	$f = 100 \text{ kHz}$			3.5	4.5		MHz
BW	Power bandwidth	$R_L = 2 \text{ k}\Omega$ , $V_{O(PP)} = 20 \text{ V}$ , $A_{VD} = 1$ , $\text{THD} = 5.0\%$				200		kHz
$\phi_m$	Phase margin	$R_L = 2 \text{ k}\Omega$ , $C_L = 0$				60°		
		$R_L = 2 \text{ k}\Omega$ , $C_L = 300 \text{ pF}$				40°		
	Gain margin	$R_L = 2 \text{ k}\Omega$ , $C_L = 0$				12		dB
		$R_L = 2 \text{ k}\Omega$ , $C_L = 300 \text{ pF}$				4		
$r_i$	Differential input resistance	$V_{IC} = 0$				150		$\text{M}\Omega$
$C_i$	Input capacitance	$V_{IC} = 0$				2.5		pF
	Channel separation	$f = 10 \text{ kHz}$				120		dB
$z_o$	Open-loop output impedance	$f = 1 \text{ MHz}$				30		$\Omega$