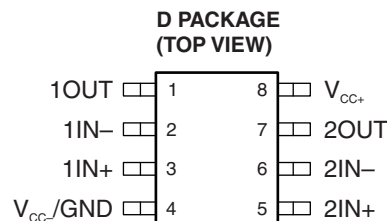


HIGH-SLEW-RATE SINGLE-SUPPLY OPERATIONAL AMPLIFIER

FEATURES

- Qualified for Automotive Applications
- Wide Gain-Bandwidth Product: 4 MHz
- High Slew Rate: 13 V/ μ s
- Fast Settling Time: 1.1 μ s to 0.1%
- Wide-Range Single-Supply Operation: 4 V to 36 V
- Wide Input Common-Mode Range Includes Ground (V_{CC-})
- Low Total Harmonic Distortion: 0.02%
- Large-Capacitance Drive Capability: 10,000 pF
- Output Short-Circuit Protection



DESCRIPTION/ORDERING INFORMATION

Quality, low-cost, bipolar fabrication with innovative design concepts is employed for the TL3472 operational amplifier. This device offers 4 MHz of gain-bandwidth product, 13-V/ μ s slew rate, and fast settling time, without the use of JFET device technology. Although the TL3472 can be operated from split supplies, it is particularly suited for single-supply operation because the common-mode input voltage range includes ground potential (V_{CC-}). With a Darlington transistor input stage, this device 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. This low-cost amplifier is an alternative to the MC33072 and the MC34072 operational amplifiers.

ORDERING INFORMATION⁽¹⁾

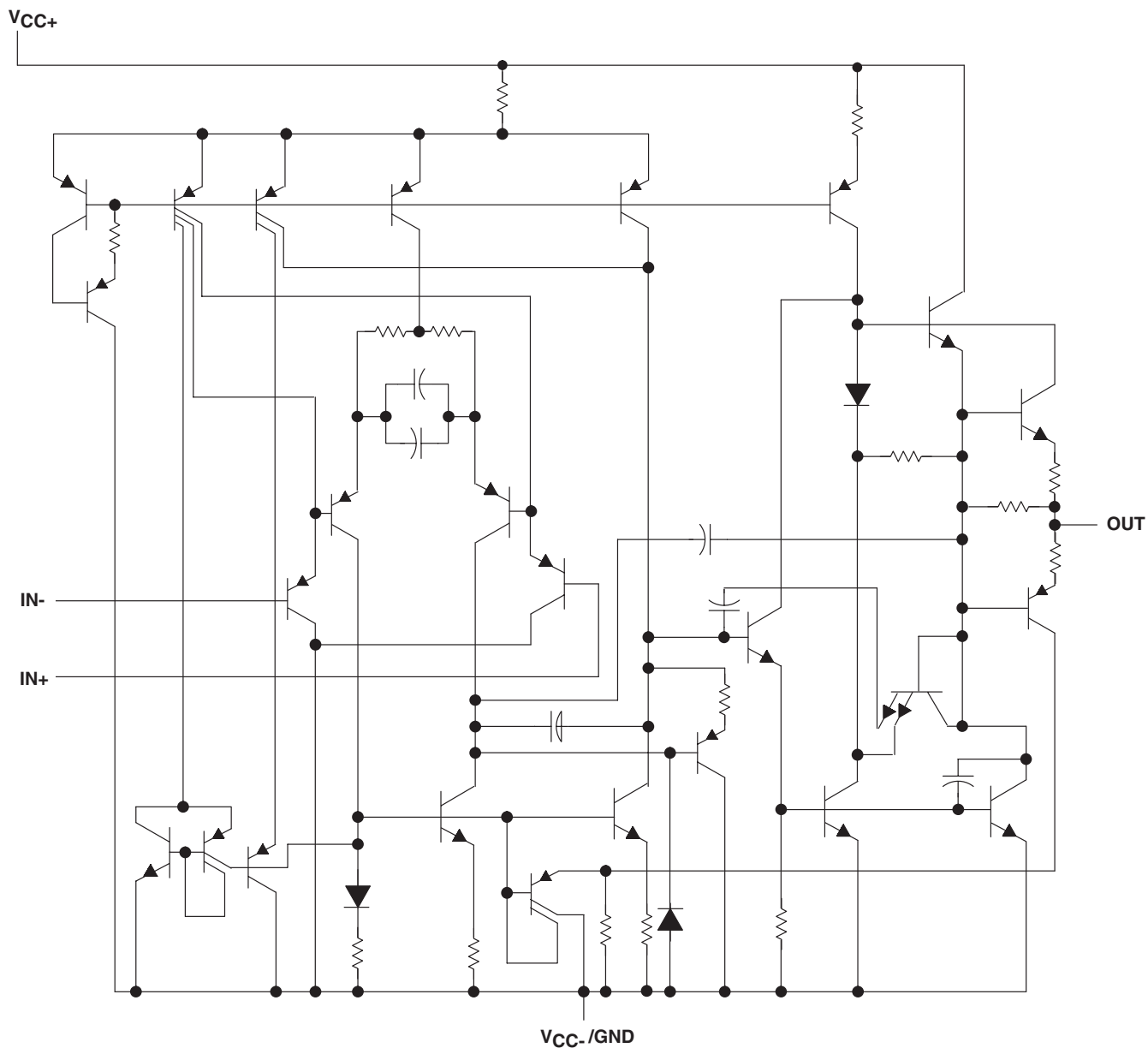
T_A	PACKAGE ⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOIC – D	Reel of 2500	TL3472QDRQ1	T3472Q

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
- (2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.



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SCHEMATIC (EACH AMPLIFIER)



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

V_{CC+}	Supply voltage ⁽²⁾	18 V
V_{CC-}		–18 V
V_{ID}	Differential input voltage	± 36 V
V_I	Input voltage (any input)	$V_{CC\pm}$
I_I	Input current (each input)	± 1 mA
I_O	Output current	± 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 ⁽³⁾	Unlimited
θ_{JA}	Package thermal impedance ⁽⁴⁾⁽⁵⁾	97°C/W
T_J	Operating virtual junction temperature	150°C
	Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds	260°C
T_{stg}	Storage temperature range	–65°C to 150°C

- (1) 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.
- (2) All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
- (3) The output can be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.
- (4) Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
- (5) The package thermal impedance is calculated in accordance with JESD 51-7.

RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT	
$V_{CC\pm}$	Supply voltage	4	36	V	
V_{IC}	Common-mode input voltage	$V_{CC} = 5$ V	0	2.8	V
		$V_{CC\pm} = \pm 15$ V	–15	12.8	
T_A	Operating free-air temperature	–40	125	°C	

ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	$T_A^{(1)}$	MIN	TYP ⁽²⁾	MAX	UNIT		
V_{IO} Input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	$V_{CC} = 5\text{ V}$	25°C	1.5	16	mV		
		$V_{CC} = \pm 15\text{ V}$	25°C	1	17			
			Full range				22	
α_{VIO} Temperature coefficient of input offset voltage	$V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	$V_{CC} = \pm 15\text{ V}$	Full range	10		$\mu\text{V}/^\circ\text{C}$		
I_{IO} Input offset current	$V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	$V_{CC} = \pm 15\text{ V}$	25°C	6	75	nA		
			Full range				300	
I_{IB} Input bias current	$V_{IC} = 0, V_O = 0, R_S = 50\ \Omega$	$V_{CC} = \pm 15\text{ V}$	25°C	100	500	nA		
			Full range				700	
V_{ICR} Common-mode input voltage range	$R_S = 50\ \Omega$		25°C	-15 to 12.8		V		
			Full range				-15 to 12.8	
V_{OH} High-level output voltage	$V_{CC+} = 5\text{ V}, V_{CC-} = 0, R_L = 2\text{ k}\Omega$	25°C	3.7	4	V			
	$R_L = 10\text{ k}\Omega$	25°C	13.6	14				
	$R_L = 2\text{ k}\Omega$	Full range		13.4				
V_{OL} Low-level output voltage	$V_{CC+} = 5\text{ V}, V_{CC-} = 0, R_L = 2\text{ k}\Omega$	25°C	0.1	0.3	V			
	$R_L = 10\text{ k}\Omega$	25°C	-14.7	-14.3				
	$R_L = 2\text{ k}\Omega$	Full range		-13.5				
A_{VD} Large-signal differential voltage amplification	$V_O = \pm 10\text{ V}, R_L = 2\text{ k}\Omega$		25°C	25	100	V/mV		
			Full range				20	
I_{OS} Short-circuit output current	Source: $V_{ID} = 1\text{ V}, V_O = 0$	25°C		-10	-34	mA		
	Sink: $V_{ID} = -1\text{ V}, V_O = 0$			20	27			
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICR}(\text{min}), R_S = 50\ \Omega$	25°C	65	97	dB			
k_{SVR} Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC\pm} = \pm 13.5\text{ V to } \pm 16.5\text{ V}, R_S = 100\ \Omega$	25°C	70	97	dB			
I_{CC} Supply current (per channel)	$V_O = 0, \text{ No load}$		25°C	3.5	4.5	mA		
			Full range				4.5	5.5
			25°C				3.5	4.5

(1) Full range $T_A = -40^\circ\text{C to } 125^\circ\text{C}$

(2) All typical values are at $T_A = 25^\circ\text{C}$.

OPERATING CHARACTERISTICS
 $V_{CC\pm} = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SR+	Positive slew rate	$V_I = -10\text{ V to } 10\text{ V}$, $R_L = 2\text{ k}\Omega$, $C_L = 300\text{ pF}$	$A_V = 1$	8	10		V/ μs
SR-	Negative slew rate	$V_I = -10\text{ V to } 10\text{ V}$, $R_L = 2\text{ k}\Omega$, $C_L = 300\text{ pF}$	$A_V = -1$		13		V/ μs
t_s	Settling time	$A_{VD} = -1$, 10-V step	$T_O 0.1\%$		1.1		μs
			$T_O 0.01\%$		2.2		
V_n	Equivalent input noise voltage	$f = 1\text{ kHz}$, $R_S = 100\ \Omega$			49		nV/ $\sqrt{\text{Hz}}$
I_n	Equivalent input noise current	$f = 1\text{ kHz}$			0.22		pA/ $\sqrt{\text{Hz}}$
THD	Total harmonic distortion	$V_{O(PP)} = 2\text{ V to } 20\text{ V}$, $R_L = 2\text{ k}\Omega$, $A_{VD} = 10$, $f = 10\text{ kHz}$			0.02		%
GBW	Gain-bandwidth product	$f = 100\text{ kHz}$		3	4		MHz
BW	Power bandwidth	$V_{O(PP)} = 20\text{ V}$, $R_L = 2\text{ k}\Omega$, $A_{VD} = 1$, THD = 5.0%			160		kHz
ϕ_m	Phase margin	$R_L = 2\text{ k}\Omega$	$C_L = 0$		70		deg
			$C_L = 300\text{ pF}$		50		
	Gain margin	$R_L = 2\text{ k}\Omega$	$C_L = 0$		12		dB
			$C_L = 300\text{ pF}$		4		
r_i	Differential input resistance	$V_{IC} = 0$			150		M Ω
C_i	Input capacitance	$V_{IC} = 0$			2.5		pF
	Channel separation	$f = 10\text{ kHz}$			101		dB
z_o	Open-loop output impedance	$f = 1\text{ MHz}$, $A_V = 1$			20		Ω

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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