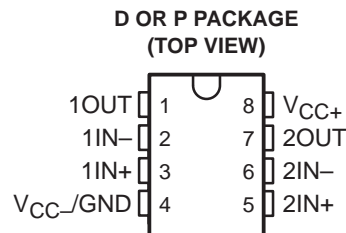


- **Wide Gain-Bandwidth Product . . . 4 MHz**
- **High Slew Rate . . . 13 V/μs**
- **Fast Settling Time . . . 1.1 μs to 0.1%**
- **Wide-Range Single-Supply Operation . . . 4 V to 36 V**
- **Wide Input Common-Mode Range Includes Ground (V_{CC-})**
- **Low Total Harmonic Distortion . . . 0.02%**
- **Large-Capacitance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



description

Quality, low-cost, bipolar fabrication with innovative design concepts are employed for the TL3472 operational amplifier. This device offers 4 MHz of gain-bandwidth product, 13-V/μs 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.

The TL3472C is characterized for operation from 0°C to 70°C. The TL3472I is characterized for operation from -40°C to 105°C.

AVAILABLE OPTIONS

| T _A | PACKAGED DEVICES | |
|----------------|-------------------|--------------------------|
| | SMALL OUTLINE (D) | PLASTIC DUAL-IN-LINE (P) |
| 0°C to 70°C | TL3472CD | TL3472CP |
| -40°C to 105°C | TL3472ID | TL3472IP |

D package is available taped and reeled. Add the suffix R to device type (e.g., TL3472CDR).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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



TL3472

HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIER

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

| | |
|---|----------------|
| Supply voltage (see Note 1): V_{CC+} | 18 V |
| V_{CC-} | -18 V |
| Differential input voltage, V_{ID} (see Note 2) | ± 36 V |
| Input voltage, V_I (any input) | $V_{CC\pm}$ |
| 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 |
| Package thermal impedance, θ_{JA} (see Notes 4 and 5): D package | 97°C/W |
| P package | 85°C/W |
| Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds | 260°C |
| Storage temperature range, T_{stg} | -65°C to 150°C |

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

- NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
 2. Differential voltages are at the noninverting input with respect to the inverting input. Excessive input current can flow when the input is less than $V_{CC-} - 0.3$ V.
 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.

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 | TL3472C | 0 | 70 | °C |
| | | TL3472I | -40 | 105 | |



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

| PARAMETER | | TEST CONDITIONS | T_A | MIN | TYP† | MAX | UNIT | |
|-------------------|---|--|--|-------------|-------|---------------|------------------------------|-----|
| V_{IO} | Input offset voltage | $V_{IC} = 0,$ $V_O = 0,$ $R_S = 50 \Omega$ | $V_{CC} = 5$ V | 25°C | 1.5 | 10 | mV | |
| | | | $V_{CC} = \pm 15$ V | 25°C | 1.0 | 10 | | |
| | | | | Full range‡ | | | | 12 |
| $\alpha_{V_{IO}}$ | Temperature coefficient of input offset voltage | $V_{IC} = 0,$ $V_O = 0,$ $R_S = 50 \Omega$ | $V_{CC} = \pm 15$ V | Full range‡ | 10 | | $\mu\text{V}/^\circ\text{C}$ | |
| I_{IO} | Input offset current | | $V_{CC} = \pm 15$ V | 25°C | 6 | 75 | nA | |
| | | | | Full range‡ | | | | 300 |
| I_{IB} | Input bias current | $V_{CC} = \pm 15$ V | 25°C | 100 | 500 | μA | | |
| | | | 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 |
| V_{OH} | High-level output voltage | $V_{CC+} = 5$ V, $V_{CC-} = 0,$ $R_L = 2$ k Ω | 25°C | 3.7 | 4 | V | | |
| | | | $R_L = 10$ k Ω | 25°C | 13.6 | | 14 | |
| | | | Full range‡ | | | | 13.4 | |
| V_{OL} | Low-level output voltage | $V_{CC+} = 5$ V, $V_{CC-} = 0,$ $R_L = 2$ k Ω | 25°C | 0.1 | 0.3 | V | | |
| | | | $R_L = 10$ k Ω | 25°C | -14.7 | | -14.3 | |
| | | | Full range‡ | | | | -13.5 | |
| A_{VD} | Large-signal differential voltage amplification | $V_O = \pm 10$ V, $R_L = 2$ k Ω | 25°C | 25 | 100 | V/mV | | |
| | | | Full range‡ | | | | 20 | |
| I_{OS} | Short-circuit output current | Source: $V_{ID} = 1$ V, $V_O = 0$ | 25°C | -10 | -34 | mA | | |
| | | Sink: $V_{ID} = -1$ 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 ($\Delta V_{CC\pm}/\Delta V_{IO}$) | $V_{CC\pm} = \pm 13.5$ V to ± 16.5 V, $R_S = 100 \Omega$ | 25°C | 70 | 97 | dB | | |
| I_{CC} | Supply current (per channel) | $V_O = 0,$ No load | 25°C | 3.5 | 4.5 | mA | | |
| | | | Full range‡ | | | | 4.5 | 5.5 |
| | | | $V_{CC+} = 5$ V, $V_O = 2.5$ V, $V_{CC-} = 0,$ No load | 25°C | 3.5 | | 4.5 | |

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

‡ Full range is 0°C to 70°C for the TL3472C device and -40°C to 105°C for the TL3472I device.

TL3472

HIGH-SLEW-RATE, SINGLE-SUPPLY OPERATIONAL AMPLIFIER

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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 | | $\text{V}/\mu\text{s}$ |
| SR- | Negative slew rate | | $A_V = -1$ | | 13 | | $\text{V}/\mu\text{s}$ |
| t_s | Settling time | $A_{VD} = -1$, 10-V step | To 0.1% | | 1.1 | | μs |
| | | | To 0.01% | | 2.2 | | |
| V_n | Equivalent input noise voltage | $f = 1\text{ kHz}$, | $R_S = 100\ \Omega$ | | 49 | | $\text{nV}/\sqrt{\text{Hz}}$ |
| I_n | Equivalent input noise current | $f = 1\text{ kHz}$ | | | 0.22 | | $\text{pA}/\sqrt{\text{Hz}}$ |
| THD | Total harmonic distortion | $V_{O(PP)} = 2\text{ V to } 20\text{ V}$, $R_L = 2\text{ k}\Omega$, $A_{VD} = 10$, $f = 10\text{ kHz}$ | | | 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 | | $\text{M}\Omega$ |
| 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 |



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