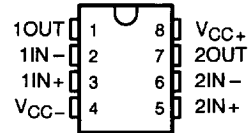


# TLV2362I, TLV2362Y DUAL HIGH-PERFORMANCE, LOW-VOLTAGE OPERATIONAL AMPLIFIERS

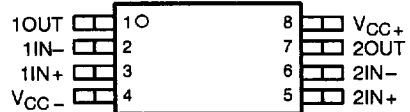
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- **Low Supply Voltage Operation**  
 $V_{CC} = \pm 1 \text{ V Min}$
- **Wide Output Voltage Swing**  
 $\pm 2.4 \text{ V Typ at } V_{CC\pm} = \pm 2.5 \text{ V, } R_L = 10 \text{ k}\Omega$
- **Wide Bandwidth**  
 $7 \text{ MHz Typ at } V_{CC\pm} = 2.5 \text{ V}$
- **Low Noise** . . .  $8 \text{ nV}/\sqrt{\text{Hz}} \text{ Typ at } f = 1 \text{ kHz}$
- **High Slew Rate**  
 $4 \text{ V}/\mu\text{sec Typ at } V_{CC\pm} = \pm 2.5 \text{ V}$
- **Available In Small TSSOP Packages**

**D OR P PACKAGE  
(TOP VIEW)**



**PW PACKAGE  
(TOP VIEW)**



## description

The TLV2362I is a high-performance dual operational amplifier built using an original Texas Instruments bipolar process. This device can be operated at a very low supply voltage ( $\pm 1 \text{ V}$ ), while maintaining a wide output swing. The TLV2362I offers a dramatically improved dynamic range of signal conditioning in low-voltage systems. Coupled with this high performance, the TLV2362I provides a wider unity-gain bandwidth and higher slew rate than other general-purpose operational amplifiers. With its low distortion and low noise performance, this device is well suited for audio applications. The TLV2362I is available in the thin-shrink small-outline package (TSSOP) to reduce board space requirements.

## AVAILABLE OPTIONS

| $T_A$                                    | PACKAGED DEVICES     |                    |               | CHIP FORM<br>(Y) |
|------------------------------------------|----------------------|--------------------|---------------|------------------|
|                                          | SMALL OUTLINE<br>(D) | PLASTIC DIP<br>(P) | TSSOP<br>(PW) |                  |
| $-20^\circ\text{C TO } 85^\circ\text{C}$ | TLV2362ID            | TLV2362IP          | TLV2362IPWLE  | TLV2362Y         |

The D packages are available taped and reeled. Add an R to the package suffix (e.g., TLV2362IDR).

The PW packages are only available left-ended taped and reeled, (e.g., TLV2362IPWLE).

Chip forms are specified for operation at  $25^\circ\text{C}$  only.

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.

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INSTRUMENTS**

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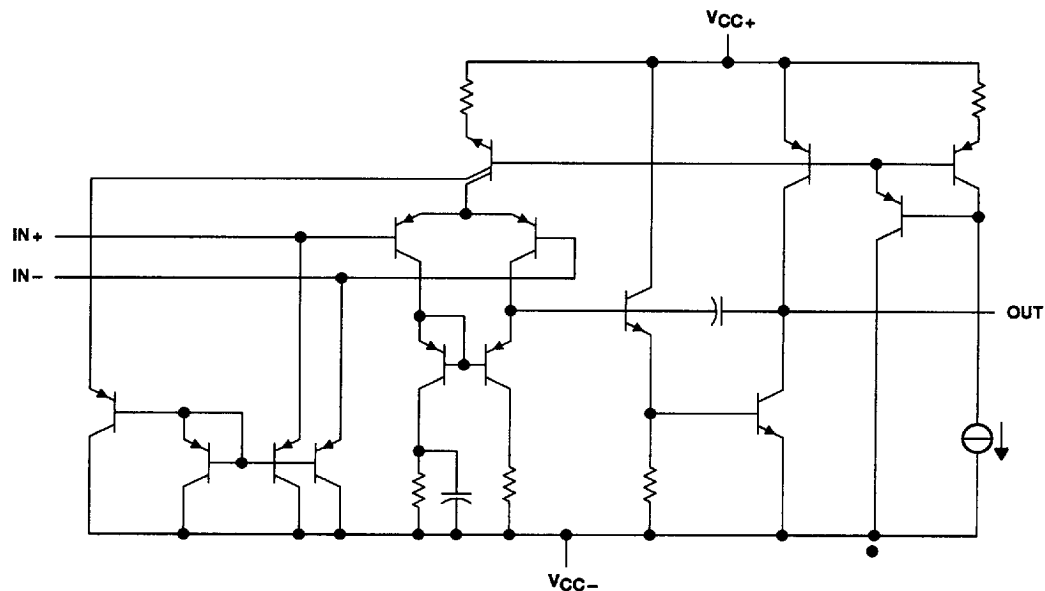
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**TLV2362I, TLV2362Y**  
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**equivalent schematic (each amplifier)**



| ACTUAL DEVICE<br>COMPONENT COUNT |    |
|----------------------------------|----|
| Capacitors                       | 4  |
| Diodes                           | 1  |
| Resistors                        | 11 |
| J-FET                            | 1  |
| Transistors                      | 46 |

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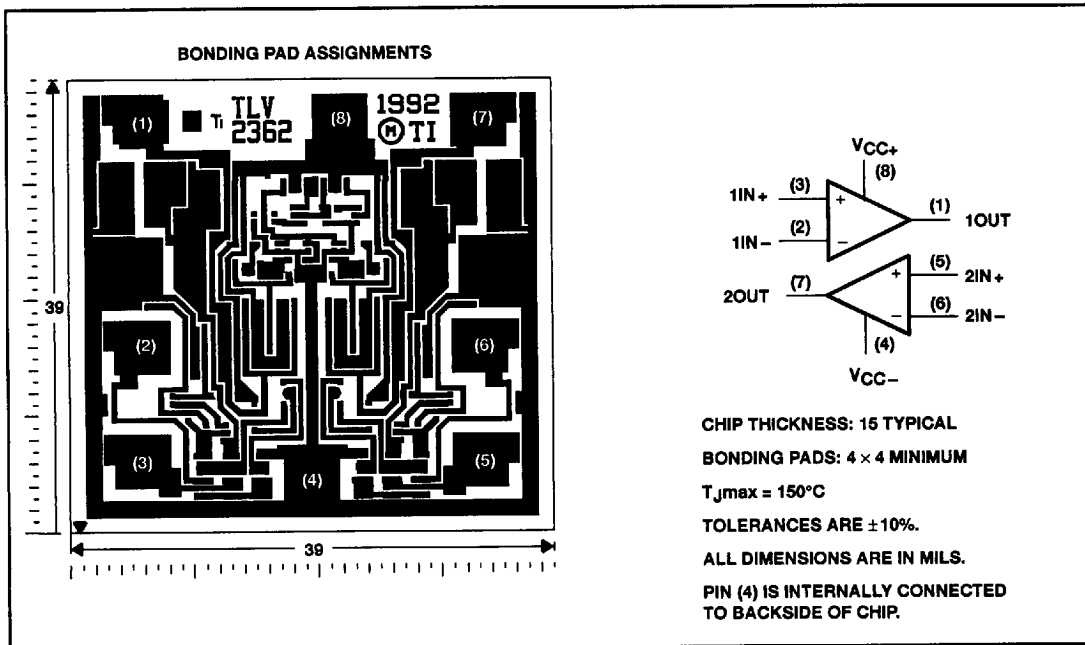
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**TLV2362Y chip information**

This chip, when properly assembled, displays characteristics similar to the TLV2362I. 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.



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# TLV2362I, TLV2362Y

## DUAL HIGH-PERFORMANCE, LOW-VOLTAGE OPERATIONAL AMPLIFIERS

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

|                                                                                   |                              |
|-----------------------------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{CC+}$ (see Note 1)                                            | 3.5 V                        |
| Supply voltage, $V_{CC-}$ (see Note 1)                                            | –3.5 V                       |
| Differential input voltage, $V_{ID}$ (see Note 2)                                 | $\pm 3.5$ V                  |
| Input voltage range, $V_I$ (any input) (see Notes 1 and 3)                        | $V_{CC\pm}$                  |
| Output voltage, $V_O$                                                             | $\pm 3.5$ V                  |
| Output current, $I_O$                                                             | 20 mA                        |
| Duration of short-circuit current at (or below) 25°C (output shorted to GND)      | unlimited                    |
| Continuous total dissipation, $P_D$ ( $T_A \leq 25^\circ\text{C}$ )               | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$                                       | –20°C to 85°C                |
| Storage temperature range                                                         | –65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, P, or PW 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.  
3. All input voltage values must not exceed  $V_{CC}$ .

### recommended operating conditions

|                                       | MIN     | MAX       | UNIT |
|---------------------------------------|---------|-----------|------|
| Supply voltage, $V_{CC}$              | $\pm 1$ | $\pm 2.5$ | V    |
| Operating free-air temperature, $T_A$ | –20     | 85        | °C   |

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A \leq 85^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|---------------------------------------------------|---------------------------------------------|
| D       | 725 mW                                      | 5.8 mW/°C                                         | 377 mW                                      |
| P       | 1000 mW                                     | 8.0 mW/°C                                         | 520 mW                                      |
| PW      | 525 mW                                      | 4.2 mW/°C                                         | 273 mW                                      |

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**electrical characteristics,  $V_{CC\pm} = \pm 1.5$  V (unless otherwise noted)**

| PARAMETER                                                | TEST CONDITIONS                        | $T_A$         | TLV2362I |           |      | UNIT |
|----------------------------------------------------------|----------------------------------------|---------------|----------|-----------|------|------|
|                                                          |                                        |               | MIN      | TYP       | MAX  |      |
| $V_{IO}$ Input offset voltage                            | $V_O = 0, \quad V_{IC} = 0$            | 25°C          |          | 1         | 6    | mV   |
|                                                          |                                        | –20°C to 85°C |          |           | 7.5  |      |
| $I_{IO}$ Input offset current                            | $V_O = 0, \quad V_{IC} = 0$            | 25°C          |          | 5         | 100  | nA   |
|                                                          |                                        | –20°C to 85°C |          |           | 150  |      |
| $I_{IB}$ Input bias current                              | $V_O = 0, \quad V_{IC} = 0$            | 25°C          |          | 20        | 150  | nA   |
|                                                          |                                        | –20°C to 85°C |          |           | 250  |      |
| $V_{ICR}$ Common-mode input voltage                      | $ V_{IO}  \leq 7.5$ mV                 | 25°C          |          | $\pm 0.5$ |      | V    |
|                                                          |                                        | –20°C to 85°C |          | $\pm 0.5$ |      |      |
| $V_{OM+}$ Maximum positive-peak output voltage           | $R_L = 10$ k $\Omega$                  | 25°C          |          | 1.2       | 1.4  | V    |
|                                                          | $R_L \geq 10$ k $\Omega$               | –20°C to 85°C |          | 1.2       |      |      |
| $V_{OM-}$ Maximum negative-peak output voltage           | $R_L = 10$ k $\Omega$                  | 25°C          |          | –1.2      | –1.4 | V    |
|                                                          | $R_L \geq 10$ k $\Omega$               | –20°C to 85°C |          | –1.2      |      |      |
| $I_{CC}$ Supply current (both amplifiers)                | $V_O = 0, \quad$ No load               | 25°C          |          | 2.8       | 4.5  | mA   |
|                                                          |                                        | –20°C to 85°C |          |           | 5.5  |      |
| $A_{VD}$ Large-signal differential voltage amplification | $V_O = \pm 1$ V, $R_L = 10$ k $\Omega$ | 25°C          |          | 55        |      | dB   |
| CMRR Common-mode rejection ratio                         | $V_{IC} = \pm 0.5$ V                   | 25°C          |          | 75        |      | dB   |
| kSVR Supply-voltage rejection ratio                      | $V_{CC\pm} = \pm 1.5$ V to $\pm 2.5$ V | 25°C          |          | 80        |      | dB   |

**operating characteristics,  $V_{CC\pm} = \pm 1.5$  V,  $T_A = 25^\circ\text{C}$**

| PARAMETER                            | TEST CONDITIONS                                                | TLV2362I |     |     | UNIT                   |
|--------------------------------------|----------------------------------------------------------------|----------|-----|-----|------------------------|
|                                      |                                                                | MIN      | TYP | MAX |                        |
| SR Slew rate                         | $A_V = 1, \quad V_I = \pm 0.5$ V                               |          | 2.5 |     | V/ $\mu$ s             |
| $B_1$ Unity-gain bandwidth           | $A_V = 40, \quad R_L = 10$ k $\Omega, \quad C_L = 100$ pF      |          | 6   |     | MHz                    |
| $V_n$ Equivalent input noise voltage | $R_S = 20$ $\Omega, \quad R_F = 2$ k $\Omega, \quad f = 1$ kHz |          | 9   |     | nV/ $\sqrt{\text{Hz}}$ |

**TLV2362I, TLV2362Y**  
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**electrical characteristics,  $V_{CC\pm} = \pm 2.5$  V (unless otherwise noted)**

| PARAMETER                                                | TEST CONDITIONS                        | $T_A$         | TLV2362I |           |      | UNIT |
|----------------------------------------------------------|----------------------------------------|---------------|----------|-----------|------|------|
|                                                          |                                        |               | MIN      | TYP       | MAX  |      |
| $V_{IO}$ Input offset voltage                            | $V_O = 0, V_{IC} = 0$                  | 25°C          |          | 1         | 6    | mV   |
|                                                          |                                        | -20°C to 85°C |          |           | 7.5  |      |
| $I_{IO}$ Input offset current                            | $V_O = 0, V_{IC} = 0$                  | 25°C          |          | 5         | 100  | nA   |
|                                                          |                                        | -20°C to 85°C |          |           | 150  |      |
| $I_{IB}$ Input bias current                              | $V_O = 0, V_{IC} = 0$                  | 25°C          |          | 20        | 150  | nA   |
|                                                          |                                        | -20°C to 85°C |          |           | 250  |      |
| $V_{ICR}$ Common-mode input voltage                      | $ V_{IO}  \leq 7.5$ mV                 | 25 °C         |          | $\pm 1.5$ |      | V    |
|                                                          |                                        | -20°C to 85°C |          | $\pm 1.4$ |      |      |
| $V_{OM+}$ Maximum positive-peak output voltage           | $R_L = 10$ k $\Omega$                  | 25°C          |          | 2         | 2.4  | V    |
|                                                          | $R_L \geq 10$ k $\Omega$               | -20°C to 85°C |          | 2         |      |      |
| $V_{OM-}$ Maximum negative-peak output voltage           | $R_L = 10$ k $\Omega$                  | 25°C          |          | -2        | -2.4 | V    |
|                                                          | $R_L \geq 10$ k $\Omega$               | -20°C to 85°C |          | -2        |      |      |
| $I_{CC}$ Supply current (both amplifiers)                | $V_O = 0, \text{ No load}$             | 25°C          |          | 3.5       | 5    | mA   |
|                                                          |                                        | -20°C to 85°C |          |           | 6    |      |
| $A_{VD}$ Large-signal differential voltage amplification | $V_O = \pm 1$ V, $R_L = 10$ k $\Omega$ | 25°C          |          | 60        |      | dB   |
| CMRR Common-mode rejection ratio                         | $V_{IC} = \pm 0.5$ V                   | 25°C          |          | 85        |      | dB   |
| kSVR Supply-voltage rejection ratio                      | $V_{CC\pm} = \pm 1.5$ V to $\pm 2.5$ V | 25°C          |          | 80        |      | dB   |

**operating characteristics,  $V_{CC\pm} = \pm 2.5$  V,  $T_A = 25^\circ\text{C}$**

| PARAMETER                            | TEST CONDITIONS                                    | TLV2362I |     |     | UNIT                   |
|--------------------------------------|----------------------------------------------------|----------|-----|-----|------------------------|
|                                      |                                                    | MIN      | TYP | MAX |                        |
| SR Slew rate                         | $A_V = 1, V_I = \pm 0.5$ V                         |          | 3   |     | V/ $\mu$ s             |
| $B_1$ Unity-gain bandwidth           | $A_V = 40, R_L = 10$ k $\Omega, C_L = 100$ pF      |          | 7   |     | MHz                    |
| $V_n$ Equivalent input noise voltage | $R_S = 20$ $\Omega, R_F = 2$ k $\Omega, f = 1$ kHz |          | 8   |     | nV/ $\sqrt{\text{Hz}}$ |

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**electrical characteristics,  $V_{CC\pm} = \pm 1.5$  V,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

| PARAMETER                                                | TEST CONDITIONS                        | TLV2362Y |           |      | UNIT |
|----------------------------------------------------------|----------------------------------------|----------|-----------|------|------|
|                                                          |                                        | MIN      | TYP       | MAX  |      |
| $V_{IO}$ Input offset voltage                            | $V_O = 0, V_{IC} = 0$                  |          | 1         | 6    | mV   |
| $I_{IO}$ Input offset current                            | $V_O = 0, V_{IC} = 0$                  |          | 5         | 100  | nA   |
| $I_{IB}$ Input bias current                              | $V_O = 0, V_{IC} = 0$                  |          | 20        | 150  | nA   |
| $V_{ICR}$ Common-mode input voltage                      | $ V_{IO}  \leq 7.5$ mV                 |          | $\pm 0.5$ |      | V    |
| $V_{OM+}$ Maximum positive-peak output voltage           | $R_L = 10$ k $\Omega$                  |          | 1.2       | 1.4  | V    |
| $V_{OM-}$ Maximum negative-peak output voltage           | $R_L = 10$ k $\Omega$                  |          | -1.2      | -1.4 |      |
| $I_{CC}$ Supply current (both amplifiers)                | $V_O = 0, \text{No load}$              |          | 2.8       | 4.5  | mA   |
| $A_{VD}$ Large-signal differential voltage amplification | $V_O = \pm 1$ V, $R_L = 10$ k $\Omega$ |          | 55        |      | dB   |
| CMRR Common-mode rejection ratio                         | $V_{IC} = \pm 0.5$ V                   |          | 75        |      | dB   |
| kSVR Supply-voltage rejection ratio                      | $V_{CC\pm} = \pm 1.5$ V to $\pm 2.5$ V |          | 80        |      | dB   |

**operating characteristics,  $V_{CC\pm} = \pm 1.5$  V,  $T_A = 25^\circ\text{C}$**

| PARAMETER                            | TEST CONDITIONS                                    | TLV2362Y |     |     | UNIT                   |
|--------------------------------------|----------------------------------------------------|----------|-----|-----|------------------------|
|                                      |                                                    | MIN      | TYP | MAX |                        |
| SR Slew rate                         | $A_V = 1, V_I = \pm 0.5$ V                         |          | 2.5 |     | V/ $\mu$ s             |
| $B_1$ Unity-gain bandwidth           | $A_V = 40, R_L = 10$ k $\Omega, C_L = 100$ pF      |          | 6   |     | MHz                    |
| $V_n$ Equivalent input noise voltage | $R_S = 20$ $\Omega, R_F = 2$ k $\Omega, f = 1$ kHz |          | 9   |     | nV/ $\sqrt{\text{Hz}}$ |

**electrical characteristics,  $V_{CC\pm} = \pm 2.5$  V,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

| PARAMETER                                                | TEST CONDITIONS                        | TLV2362Y |           |      | UNIT |
|----------------------------------------------------------|----------------------------------------|----------|-----------|------|------|
|                                                          |                                        | MIN      | TYP       | MAX  |      |
| $V_{IO}$ Input offset voltage                            | $V_O = 0, V_{IC} = 0$                  |          | 1         | 6    | mV   |
| $I_{IO}$ Input offset current                            | $V_O = 0, V_{IC} = 0$                  |          | 5         | 100  | nA   |
| $I_{IB}$ Input bias current                              | $V_O = 0, V_{IC} = 0$                  |          | 20        | 150  | nA   |
| $V_{ICR}$ Common-mode input voltage                      | $ V_{IO}  \leq 7.5$ mV                 |          | $\pm 1.5$ |      | V    |
| $V_{OM+}$ Maximum positive-peak output voltage           | $R_L = 10$ k $\Omega$                  |          | 2         | 2.4  | V    |
| $V_{OM-}$ Maximum negative-peak output voltage           | $R_L = 10$ k $\Omega$                  |          | -2        | -2.4 |      |
| $I_{CC}$ Supply current (both amplifiers)                | $V_O = 0, \text{No load}$              |          | 3.5       | 5    | mA   |
| $A_{VD}$ Large-signal differential voltage amplification | $V_O = \pm 1$ V, $R_L = 10$ k $\Omega$ |          | 60        |      | dB   |
| CMRR Common-mode rejection ratio                         | $V_{IC} = \pm 0.5$ V                   |          | 85        |      | dB   |
| kSVR Supply-voltage rejection ratio                      | $V_{CC\pm} = \pm 1.5$ V to $\pm 2.5$ V |          | 80        |      | dB   |

**operating characteristics,  $V_{CC\pm} = \pm 2.5$  V,  $T_A = 25^\circ\text{C}$**

| PARAMETER                            | TEST CONDITIONS                                    | TLV2362Y |     |     | UNIT                   |
|--------------------------------------|----------------------------------------------------|----------|-----|-----|------------------------|
|                                      |                                                    | MIN      | TYP | MAX |                        |
| SR Slew rate                         | $A_V = 1, V_I = \pm 0.5$ V                         |          | 3   |     | V/ $\mu$ s             |
| $B_1$ Unity-gain bandwidth           | $A_V = 40, R_L = 10$ k $\Omega, C_L = 100$ pF      |          | 7   |     | MHz                    |
| $V_n$ Equivalent input noise voltage | $R_S = 20$ $\Omega, R_F = 2$ k $\Omega, f = 1$ kHz |          | 8   |     | nV/ $\sqrt{\text{Hz}}$ |

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