

# Precision-Matched Resistor-Divider in SOT23

## ABSOLUTE MAXIMUM RATINGS

Voltage Between P1 and P2.....50V  
 Continuous Current into Any Pin.....±1.75mA  
 Continuous Power Dissipation (T<sub>A</sub> = +70°C)  
 3-Pin SOT23 (derate 7.1mW/°C above +70°C).....571.4mW

Operating Temperature Range .....-40°C to +85°C  
 Junction Temperature.....+150°C  
 Storage Temperature Range.....-65°C to +150°C  
 Lead Temperature (soldering, 10s).....+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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## DC ELECTRICAL CHARACTERISTICS

(T<sub>A</sub> = -40°C to +85°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER                                                | SYMBOL             | CONDITIONS                        | MIN  | TYP   | MAX    | UNITS  |
|----------------------------------------------------------|--------------------|-----------------------------------|------|-------|--------|--------|
| Initial Resistor Ratio Error (Note 2)                    |                    | MAX5491_A, T <sub>A</sub> = +25°C |      |       | ±0.035 | %      |
|                                                          |                    | MAX5491_B, T <sub>A</sub> = +25°C |      |       | ±0.05  |        |
|                                                          |                    | MAX5491_C, T <sub>A</sub> = +25°C |      |       | ±0.1   |        |
| Resistance-Ratio Temperature Coefficient (Note 3)        |                    | 1:1 ≤ ratio ≤ 3.2:1               |      | 2     |        | ppm/°C |
|                                                          |                    | 3.2:1 < ratio ≤ 10:1              |      | 4     |        |        |
|                                                          |                    | 10:1 < ratio ≤ 30:1               |      | 5.5   |        |        |
| Absolute Temperature Coefficient of Resistance           | TCR                | (Note 4)                          |      | 35    |        | ppm/°C |
| Voltage Coefficient of Resistance                        | VCR                | (Note 5)                          |      | 0.1   |        | ppm/V  |
| End-to-End Resistance (R <sub>1</sub> + R <sub>2</sub> ) |                    |                                   | 28.5 | 30    | 31.5   | kΩ     |
| Continuous Current                                       |                    | I <sub>R1</sub> , I <sub>R2</sub> |      |       | ±1.75  | mA     |
| Continuous Working Voltage Between P1 and P2             | V <sub>P1-P2</sub> |                                   | 0    |       | 50     | V      |
| Power Rating                                             |                    |                                   |      |       | 87.5   | mW     |
| Pin Capacitance                                          |                    |                                   |      | 2     |        | pF     |
| Resistance Ratio Long-Term Stability                     |                    | 2000hr at +70°C                   |      | ±0.03 |        | %      |

**Note 1:** The MAX5491 is 100% production tested at T<sub>A</sub> = +25°C. Specifications over -40°C to +85°C are guaranteed by design.

**Note 2:** Testing conditions: T<sub>A</sub> = +25°C, V<sub>P1-P2</sub> = 9V and 50V.

**Note 3:** Resistance-ratio temperature coefficient is defined as

$$\left| \frac{\Delta \left( \frac{R_1}{R_2} \right)}{\frac{R_1}{R_2} \times \Delta T} \right|$$

**Note 4:** Absolute TCR is defined as  
 and is tested at 9V and 50V.

$$\left| \frac{\Delta(R_1 + R_2)}{(R_1 + R_2) \times \Delta T} \right|$$

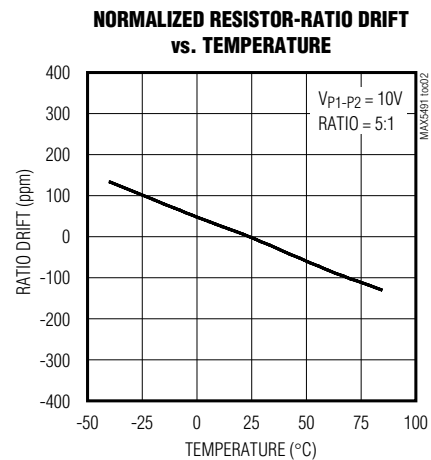
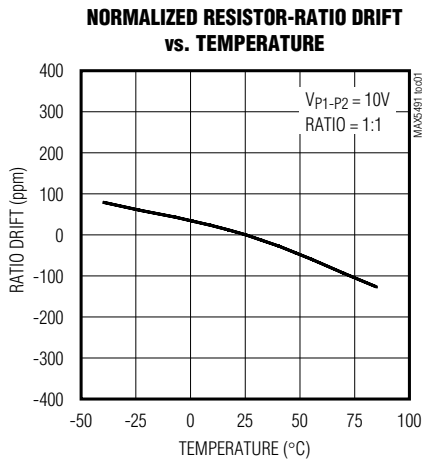
**Note 5:** Resistance-ratio voltage coefficient is defined as

$$\left| \frac{\Delta \left( \frac{R_1}{R_2} \right)}{\frac{R_1}{R_2} \times \Delta V} \right|$$

# Precision-Matched Resistor-Divider in SOT23

## Typical Operating Characteristics

( $V_{P1-P2} = 10V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



## Pin Description

| PIN | NAME | FUNCTION                                                                |
|-----|------|-------------------------------------------------------------------------|
| 1   | P1   | R <sub>1</sub> Connection Terminal                                      |
| 2   | P2   | R <sub>2</sub> Connection Terminal                                      |
| 3   | P3   | Midpoint Between R <sub>1</sub> and R <sub>2</sub> Connection Terminals |

## Detailed Description

As shown in the *Block Diagram*, the MAX5491 consists of two precision, low-ratio-drift resistors with an end-to-end resistance of 30k $\Omega$  ( $R_1 + R_2$ ). P3 is the center tap of the divider. The maximum working voltage of the MAX5491 is 50V. This device offers a wide range of

resistance ratios ( $R_1/R_2$ ) from 1:1 to 30:1 and is ideally suited for precision operational amplifier gain/attenuation control. The MAX5491 features a  $\pm 2kV$  ESD protection that enhances system robustness. A maximum initial ratio accuracy of 0.035% and a low 2ppm/ $^\circ C$  ratio drift enhance system accuracy.

# Precision-Matched Resistor-Divider in SOT23

## Typical Applications

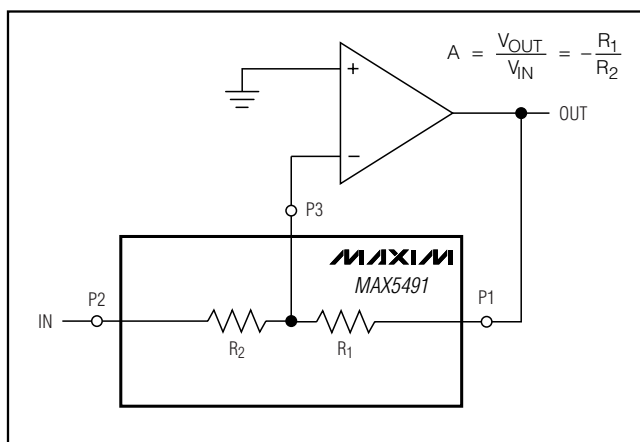


Figure 1. Inverting Amplifier Configuration

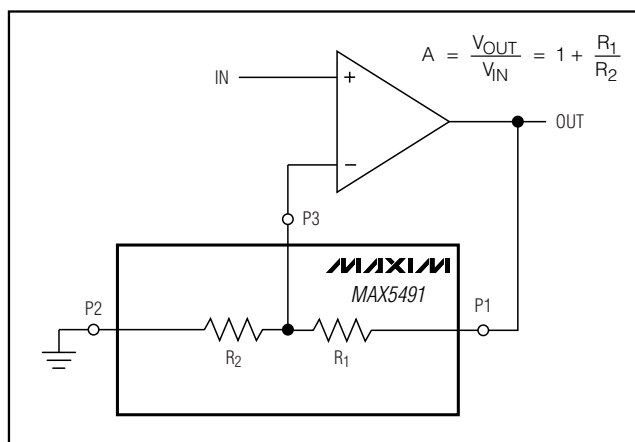


Figure 2. Noninverting Amplifier Configuration

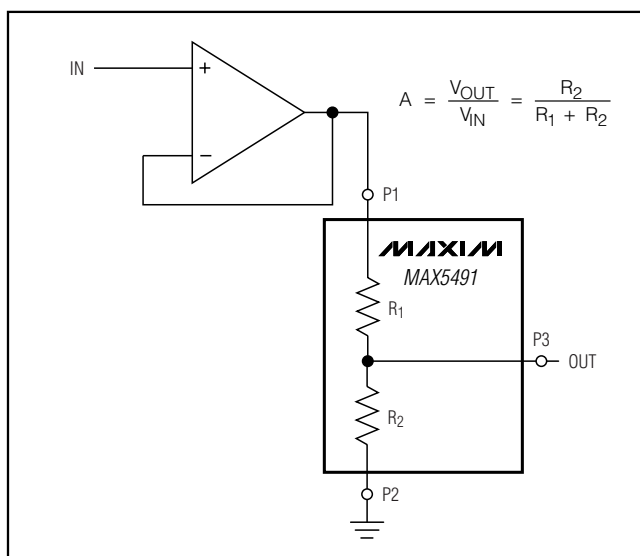


Figure 3. Buffered Attenuator

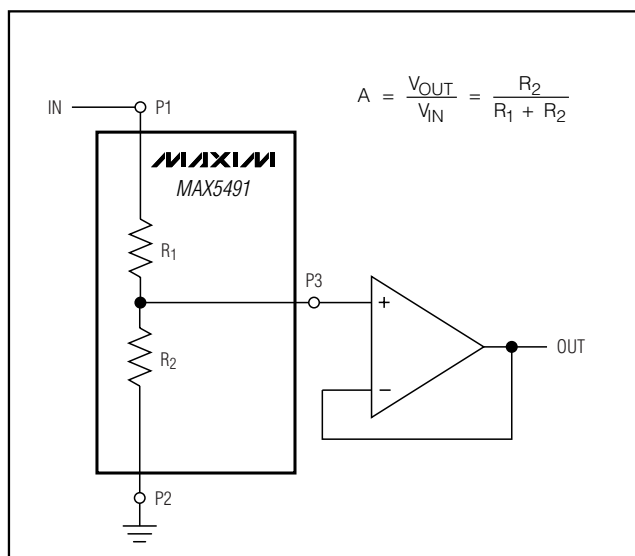


Figure 4. Attenuator with Buffer

## Applications Information

### Self-Heating and Error

Applying a voltage across terminals P1 and P2 causes the device to heat up due to power dissipation. In high-voltage applications, consider the error in resistance-ratio temperature coefficient caused by self-heating. The worst-case self-heating occurs when the operating voltage attains its maximum value. Approximate the result of power dissipation under this condition as:

$$P_{DISS} = \frac{(V_{MAX})^2}{R} = \frac{(50V)^2}{30k\Omega} = 83.3mW$$

The thermal resistance from junction to ambient,  $\theta_{JA}$ , for a 3-pin SOT23 package is 141°C/W. Calculate the resulting temperature rise as:

$$\Delta T = 83.3mW \times 141^\circ C/W = 11.7^\circ C$$

If the ratio temperature coefficient is 2ppm/°C (typ), the total error introduced by self-heating is:

$$11.7^\circ C \times 2ppm/^\circ C = 23.4ppm$$

# Precision-Matched Resistor-Divider in SOT23

## How to Order

MAX5491

### PREFIX

MAX

### ROOT PART NUMBER

MAX5491 = 30kΩ End-to-End

### RATIO RANGE

L through W. Resistor ratio must fall in the appropriate ratio range. (See Table 2.)

### RATIO ACCURACY

A = 0.035% (max); B = 0.05% (max); C = 0.1% (max)

### RESISTANCE RATIO

Five number ratio designator. Ratios available from 1:1 to 30:1.

### Format examples:

010000 = 1:1

02500 = 2.5:1

07538 = 7.538:1

25000 = 25:1

### TAPE AND REEL

## Example Part Numbers

| PART             | RESISTOR-RATIO RANGE | RESISTOR-RATIO ACCURACY (% MAX) | RESISTOR RATIO |
|------------------|----------------------|---------------------------------|----------------|
| MAX5491RA02500-T | 2.000 to 2.899       | 0.035                           | 2.5:1          |
| MAX5491VC10000-T | 10.000 to 15.999     | 0.100                           | 10:1           |
| MAX5491SB03200-T | 2.900 to 3.999       | 0.050                           | 3.2:1          |
| MAX5491UA07538-T | 6.000 to 9.999       | 0.035                           | 7.538:1        |

Table 1. Standard Ratios\*

| PART             | RESISTOR RATIO | RESISTOR-RATIO SUFFIX | RESISTOR-RATIO ACCURACY (% MAX) | TOP MARK |
|------------------|----------------|-----------------------|---------------------------------|----------|
| MAX5491LA01000-T | 1:1            | 01000                 | 0.035                           | FZPD     |
| MAX5491LB01000-T | 1:1            | 01000                 | 0.050                           | FZPE     |
| MAX5491LC01000-T | 1:1            | 01000                 | 0.100                           | FZPF     |
| MAX5491MA01100-T | 1.1:1          | 01100                 | 0.035                           | FZPA     |
| MAX5491MB01100-T | 1.1:1          | 01100                 | 0.050                           | FZPB     |
| MAX5491MC01100-T | 1.1:1          | 01100                 | 0.100                           | FZPC     |
| MAX5491NA01500-T | 1.5:1          | 01500                 | 0.035                           | FZOX     |
| MAX5491NB01500-T | 1.5:1          | 01500                 | 0.050                           | FZOY     |
| MAX5491NC01500-T | 1.5:1          | 01500                 | 0.100                           | FZOZ     |
| MAX5491PA02000-T | 2:1            | 02000                 | 0.035                           | FZOO     |
| MAX5491PB02000-T | 2:1            | 02000                 | 0.050                           | FZOP     |
| MAX5491PC02000-T | 2:1            | 02000                 | 0.100                           | FZOQ     |
| MAX5491RA02500-T | 2.5:1          | 02500                 | 0.035                           | FZPP     |

# Precision-Matched Resistor-Divider in SOT23

**Table 1. Standard Ratios\* (continued)**

| PART             | RESISTOR RATIO | RESISTOR-RATIO SUFFIX | RESISTOR-RATIO ACCURACY (% MAX) | TOP MARK |
|------------------|----------------|-----------------------|---------------------------------|----------|
| MAX5491RB02500-T | 2.5:1          | 02500                 | 0.050                           | FZPQ     |
| MAX5491RC02500-T | 2.5:1          | 02500                 | 0.100                           | FZON     |
| MAX5491SA03200-T | 3.2:1          | 03200                 | 0.035                           | FZOU     |
| MAX5491SB03200-T | 3.2:1          | 03200                 | 0.050                           | FZOV     |
| MAX5491SC03200-T | 3.2:1          | 03200                 | 0.100                           | FZOW     |
| MAX5491TA05000-T | 5:1            | 05000                 | 0.035                           | FZOR     |
| MAX5491TB05000-T | 5:1            | 05000                 | 0.050                           | FZOS     |
| MAX5491TC05000-T | 5:1            | 05000                 | 0.100                           | FZOT     |
| MAX5491UA07538-T | 7.538:1        | 07538                 | 0.035                           | FZPM     |
| MAX5491UB07538-T | 7.538:1        | 07538                 | 0.050                           | FZPN     |
| MAX5491UC07538-T | 7.538:1        | 07538                 | 0.100                           | FZPO     |
| MAX5491VA10000-T | 10:1           | 10000                 | 0.035                           | FZPJ     |
| MAX5491VB10000-T | 10:1           | 10000                 | 0.050                           | FZPK     |
| MAX5491VC10000-T | 10:1           | 10000                 | 0.100                           | FZPL     |
| MAX5491WA30000-T | 30:1           | 30000                 | 0.035                           | FZPG     |
| MAX5491WB30000-T | 30:1           | 30000                 | 0.050                           | FZPH     |
| MAX5491WC30000-T | 30:1           | 30000                 | 0.100                           | FZPI     |

\*Standard ratios are available for ordering in any quantity. Nonstandard ratios are also available for values between 1:1 to 30:1. A minimum order quantity of 10,000 units is required for nonstandard ratios. Please contact factory for more information.

**Table 2. Ratio Ranges**

| LETTER SUFFIX | RESISTOR-RATIO RANGE |
|---------------|----------------------|
| L             | 1.000 to 1.099       |
| M             | 1.100 to 1.349       |
| N             | 1.350 to 1.699       |
| P             | 1.700 to 2.000       |
| R             | 2.001 to 2.899       |
| S             | 2.900 to 3.999       |
| T             | 4.000 to 5.999       |
| U             | 6.000 to 9.999       |
| V             | 10.000 to 15.999     |
| W             | 16.000 to 30.000     |

## Chip Information

TRANSISTOR COUNT: 0  
PROCESS: BiCMOS

# Precision-Matched Resistor-Divider in SOT23

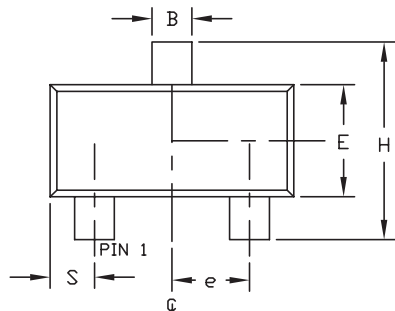
## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

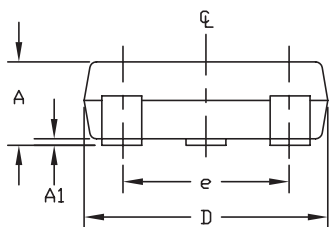
MAX5491

### NOTES:

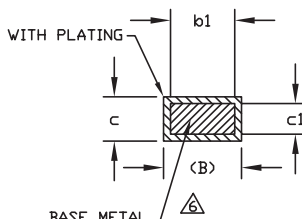
1. D&E DO NOT INCLUDE MOLD FLASH.
  2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006").
  3. CONTROLLING DIMENSION: MILLIMETERS.
  4. REFERENCE JEDEC TO236-VARIATION AB.
  5. LEADS TO BE COPLANAR WITHIN 0.10mm.
- △ DIMENSIONS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.



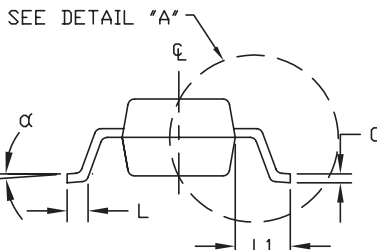
TOP VIEW



FRONT VIEW



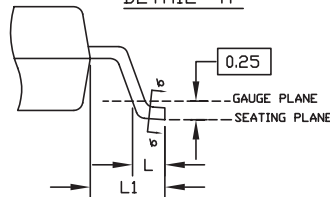
SECTION b-b



SIDE VIEW

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.035  | 0.044 | 0.890       | 1.120 |
| A1  | 0.001  | 0.004 | 0.013       | 0.100 |
| B   | 0.015  | 0.020 | 0.370       | 0.500 |
| b1  | 0.012  | 0.018 | 0.300       | 0.450 |
| c   | 0.003  | 0.071 | 0.085       | 0.180 |
| c1  | 0.003  | 0.071 | 0.080       | 0.160 |
| D   | 0.110  | 0.120 | 2.800       | 3.040 |
| E   | 0.047  | 0.055 | 1.200       | 1.400 |
| e   | 0.037  | BSC.  | 0.950       | BSC.  |
| e1  | 0.075  | BSC.  | 1.900       | BSC.  |
| H   | 0.083  | 0.104 | 2.100       | 2.640 |
| L   | 0.015  | 0.023 | 0.400       | 0.600 |
| L1  | 0.021  | REF   | 0.54        | REF   |
| S   | 0.018  | 0.024 | 0.45        | 0.60  |
| α   | 0°     | 8°    | 0°          | 8°    |

DETAIL "A"



|                                                                                                                      |                                 |                                                                                       |     |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------------------------------|-----|
|  <b>DALLAS</b><br>SEMICONDUCTOR |                                 |  |     |
| PROPRIETARY INFORMATION                                                                                              |                                 |                                                                                       |     |
| TITLE:<br>PACKAGE OUTLINE, 3L SOT-23                                                                                 |                                 |                                                                                       |     |
| APPROVAL                                                                                                             | DOCUMENT CONTROL NO.<br>21-0051 | REV.<br>F                                                                             | 1/1 |

SOT23 LEPS

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