19-3337; Rev 2; 3/05

100kΩ Precision-Matched Resistor-Divider in SOT23

MAX5490

General Description

The MAX5490 precision resistor-divider consists of two accurately matched resistors with access to the ends and center of the divider. This device offers excellent resistance matching of 0.035% (A grade), 0.05% (B grade), and 0.1% (C grade). The MAX5490 provides an extremely low resistance-ratio temperature drift of 1ppm/°C (typ) over -55°C to +125°C, and has an end-to-end resistance of 100kΩ. Resistance ratios from 1:1 to 100:1 are available. Five standard ratios are available (see Table 1), and custom ratios are also available upon request. The MAX5490 is ideal for precision gain-setting applications where tight resistance matching and low temperature drift are necessary.

The MAX5490 is available in a space-saving 3-pin SOT23 package, and is guaranteed over the military -55°C to +125°C temperature range.

Features

- ♦ **Resistance Ratios from 1:1 to 100:1**
- ♦ **Custom Ratios Available Upon Request**
- ♦ **Tight Initial Ratio Accuracy**
  - **0.035% (MAX5490A)**
  - **0.05% (MAX5490B)**
  - **0.1% (MAX5490C)**
- ♦ **Low 1ppm/°C (typ) Resistor-Ratio-Drift**
- ♦ **Up to 80V Operating Voltage Across Sum of R1 and R2**
- ♦ **Tiny 3-Pin SOT23 Package**

Applications

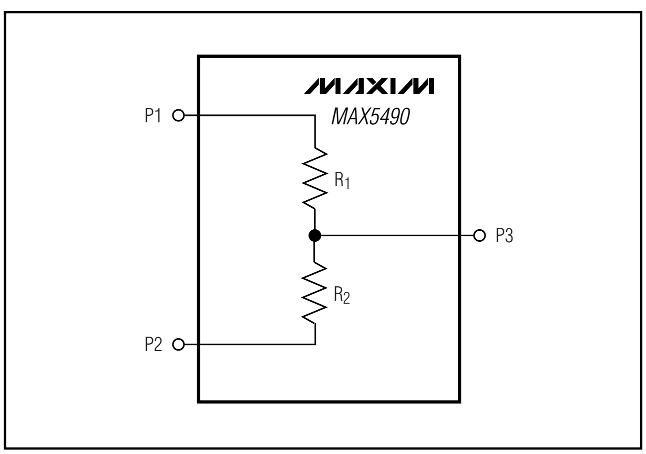
Industrial Process Control
Instrumentation
Precision Gain Setting
Medical Equipment
Automatic Test Equipment
Base Stations

Ordering Information*

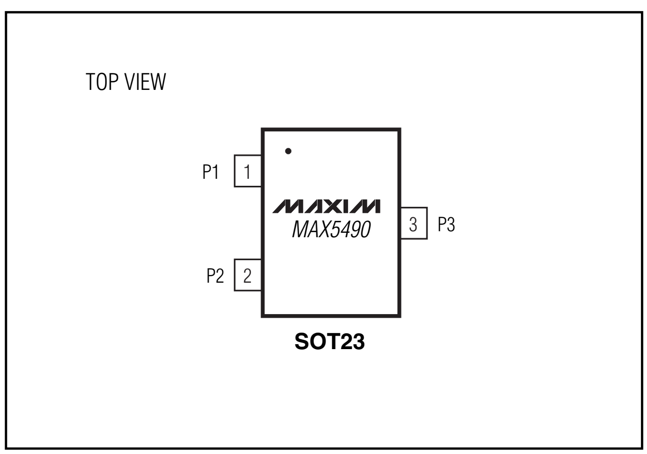
PART	TEMP RANGE	PIN-PACKAGE	RATIO ACCURACY (%)
MAX5490_A_ _ _ _ _-T	-55°C to +125°C	3 SOT23-3	0.035
MAX5490_B_ _ _ _ _-T	-55°C to +125°C	3 SOT23-3	0.05
MAX5490_C_ _ _ _ _-T	-55°C to +125°C	3 SOT23-3	0.1

*See the How to Order section for more details.

Block Diagram



Pin Configuration



100kΩ Precision-Matched Resistor-Divider in SOT23

ABSOLUTE MAXIMUM RATINGS

Voltage Between P1 and P2..100V
Maximum Current into Any Pin ....±1.00mA
Continuous Power Dissipation (T_A = +70°C)
3-Pin SOT23 (derate 7.1mW/°C above +70°C).........571.4mW
3-Pin SOT23 (θ_{J-A}) ....141°C/W

Operating Temperature Range ....-55°C to +125°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_A = -55°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Initial Resistor Ratio Error (Note 2)		MAX5490_A, T_A = +25°C			±0.035	%
		MAX5490_B, T_A = +25°C			±0.05	
		MAX5490_C, T_A = +25°C			±0.1	
Resistance-Ratio Temperature Coefficient (Note 3)		1:1 ≤ ratio ≤ 10:1		1	2	ppm/°C
		10:1 ≤ ratio ≤ 25:1		2	4	
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 ($R_1 + R_2$)		T_A = +25°C	95	100	105	kΩ
Continuous Working Voltage Between P1 and P2	V_{P1-P2}		-80		+80	V
Continuous Current		I_{R1}, I_{R2}			840	µA
P1, P2, P3 Capacitance				2		pF
Maximum Power Rating				67.2		mW
Resistance Ratio Long-Term Stability		2000 hours at +70°C		±0.03		%
-3dB Bandwidth	f_{3dB}	1:1 ratio (Note 6)		3		MHz
Thermal Noise				45		μV_{RMS}
Current Noise		In accordance with MIL-STD-2020 method 30B		-25		dB

Note 1: The MAX5490 is 100% production tested at T_A = +25°C. Specifications over -55°C to +125°C are guaranteed by design and characterization.

Note 2: Testing conditions: T_A = +25°C, V_{P1-P2} = 10V and 80V.

Note 3: Resistance-ratio temperature coefficient is defined as $\left|\dfrac{\Delta\left(\frac{R_1}{R_2}\right)}{\frac{R_1}{R_2} \times \Delta T}\right|$ and is guaranteed by design, not production tested.

For ratios from 25:1 to 100:1, contact factory.

Note 4: Absolute TCR is defined as $\left|\dfrac{\Delta(R_1 + R_2)}{(R_1 + R_2) \times \Delta T}\right|$ and is tested at 10V and 80V.

DC ELECTRICAL CHARACTERISTICS (continued)

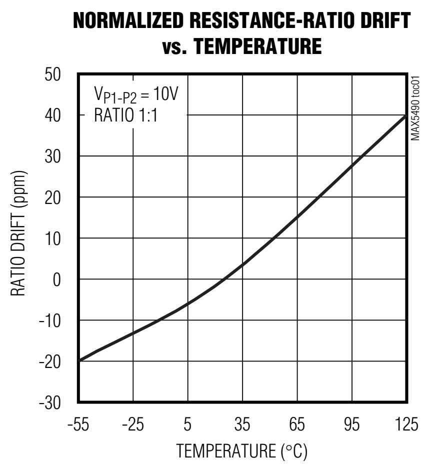
(T_A = -55°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

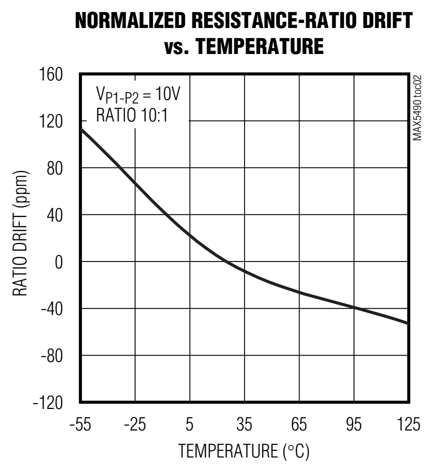
Note 5: Resistance-ratio voltage coefficient is defined as $\left|\dfrac{\Delta\left(\dfrac{R_1}{R_2}\right)}{\dfrac{R_1}{R_2} \times \Delta V}\right|$ and is guaranteed by design, not production tested.

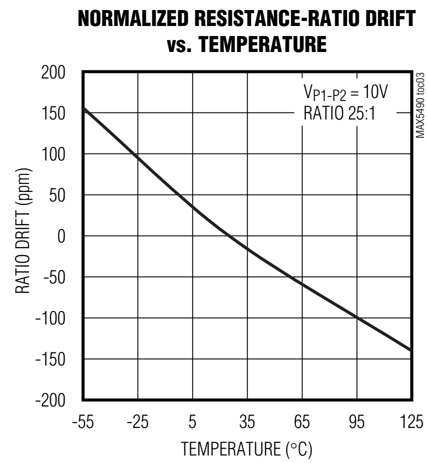
Note 6: Calculate bandwidth by using $\dfrac{1}{2\pi RC}$, where C = C_{P3} and $R = \dfrac{R_1 \times R_2}{R_1 + R_2}$.

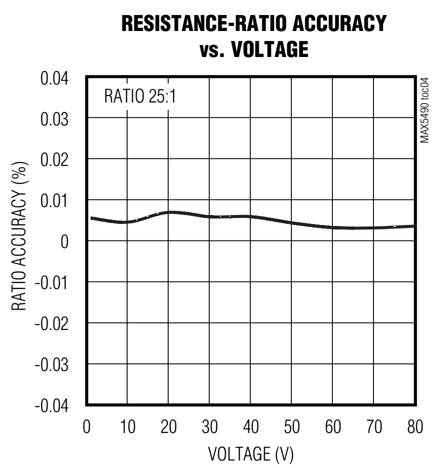
Typical Operating Characteristics

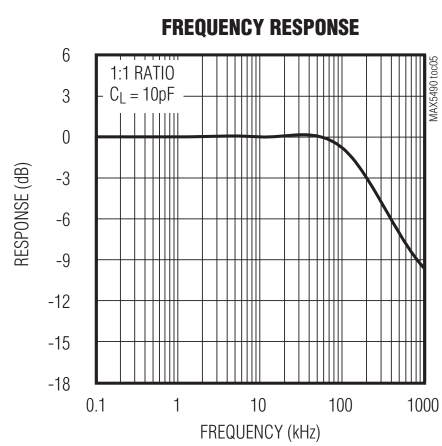
(V_{P1-P2} = 10V, T_A = +25°C, unless otherwise noted.)







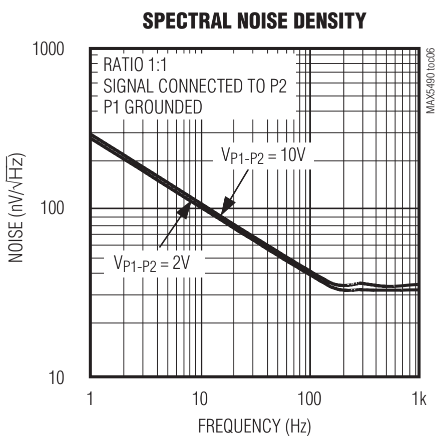


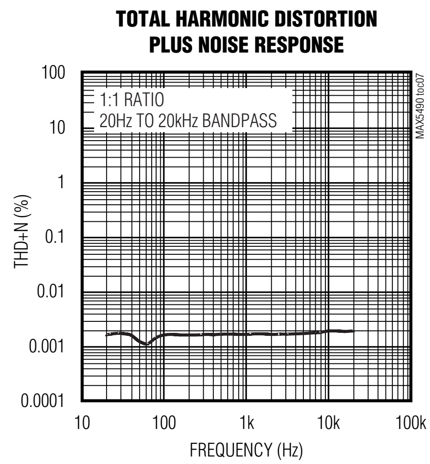


100kΩ Precision-Matched Resistor-Divider in SOT23

Typical Operating Characteristics (continued)

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





Pin Description

PIN	NAME	FUNCTION
1	P1	R_1 Connection Terminal
2	P2	R_2 Connection Terminal
3	P3	Set-Point Connection Terminal

Detailed Description

As shown in the *Block Diagram*, the MAX5490 consists of two precision, low-ratio-drift resistors with an end-to-end resistance of 100kΩ (R_1 + R_2). P3 is the set point of the divider. The maximum working voltage of the MAX5490 is 80V. This device offers a wide range of resistance ratios (R_1/R_2) from 1:1 to 100:1 and is ideal for precision operational amplifier gain/attenuation control. A maximum initial ratio accuracy of 0.035% and a low 1ppm/°C ratio drift enhance system accuracy.

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:

$$P_{DISS} = \frac{(V_{MAX})^2}{R} = \frac{(80V)^2}{100k\Omega} = 64mW$$

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

$$\Delta T = 64mW \times 141°C/W = 9.02°C$$

If the ratio temperature coefficient is 1ppm/°C (typ), the total error introduced by self-heating is:

$$9.02°C \times 1ppm/°C = 9.02ppm$$

Typical Applications

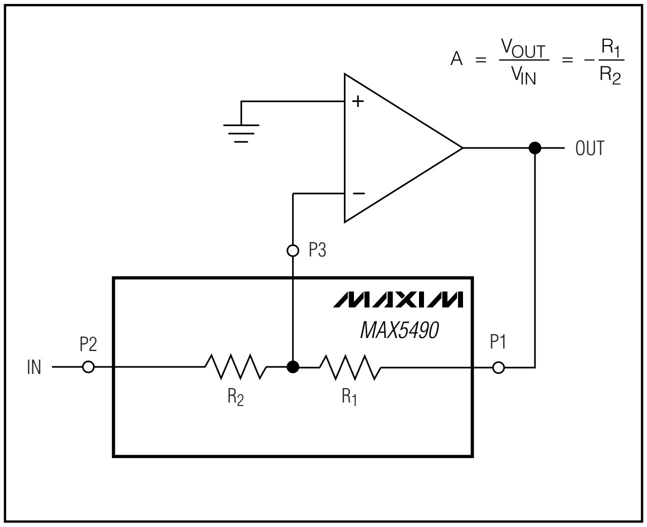


Figure 1. Inverting Amplifier Configuration

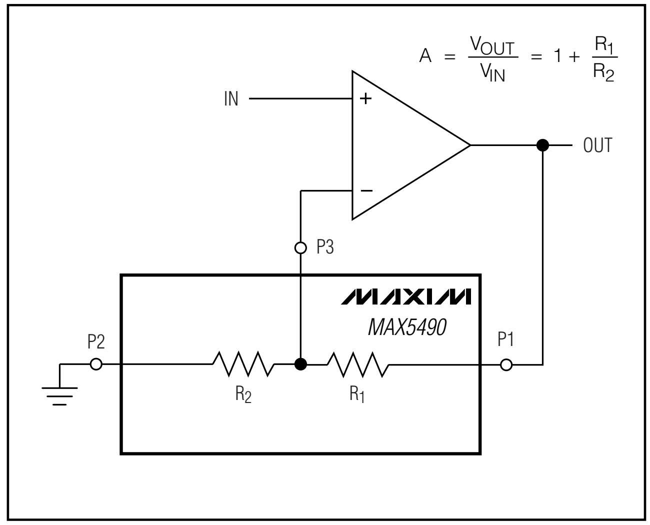


Figure 2. Noninverting Amplifier Configuration

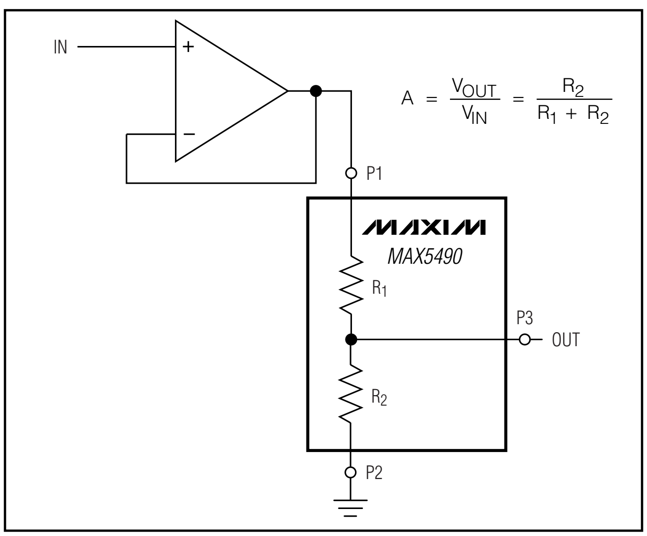


Figure 3. Buffered Attenuator

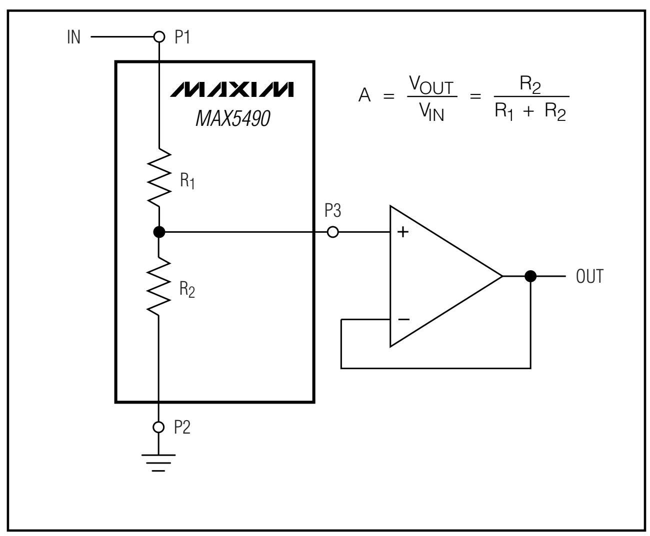


Figure 4. Attenuator with Buffer

How to Order

MAX 5490 V A 10000 -T

PREFIX

ROOT PART NUMBER
MAX5490 = 100kΩ 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 100:1.
Format examples:
01000 = 1:1
02500 = 2.5:1
07538 = 7.538:1
00000 = 100:1

TAPE AND REEL

Example Part Numbers

PART NUMBER	RESISTOR-RATIO RANGE	RESISTOR-RATIO ACCURACY (% MAX)	RESISTOR RATIO
MAX5490PA02500-T	2.000 to 2.999	0.035	2.5:1
MAX5490RB03000-T	3.000 to 3.999	0.05	3:1
MAX5490UA07538-T	7.538 to 9.999	0.035	7.538:1
MAX5490VC10000-T	10.000 to 19.999	0.1	10:1

Table 1. Standard Ratios*

PART NUMBER	RESISTOR RATIO	RESISTOR-RATIO SUFFIX	RESISTOR-RATIO ACCURACY (% MAX)	TOP MARK
MAX5490GA01000-T	1:1	01000	0.035	FZQG
MAX5490GB01000-T	1:1	01000	0.05	FZQH
MAX5490GC01000-T	1:1	01000	0.1	FZQI
MAX5490MA02000-T	2:1	02000	0.035	FZRQ
MAX5490MB02000-T	2:1	02000	0.05	FZRR
MAX5490MC02000-T	2:1	02000	0.1	FZRS
MAX5490TA05000-T	5:1	05000	0.035	FZQJ
MAX5490TB05000-T	5:1	05000	0.05	FZQK
MAX5490TC05000-T	5:1	05000	0.1	FZQL
MAX5490VA10000-T	10:1	10000	0.035	FZQP
MAX5490VB10000-T	10:1	10000	0.05	FZQQ
MAX5490VC10000-T	10:1	10000	0.1	FZQR
MAX5490XA25000-T	25:1	25000	0.035	FZQV
MAX5490XB25000-T	25:1	25000	0.05	FZQW
MAX5490XC25000-T	25:1	25000	0.1	FZQX

**Standard ratios are available for ordering in any quantity. Nonstandard ratios are also available for values between 1:1 to 100:1. 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
G	1.0 to 1.099
H	1.1 to 1.199
J	1.2 to 1.399
K	1.4 to 1.599
L	1.6 to 1.899
M	1.9 to 2.099
N	2.1 to 2.499
P	2.5 to 2.999
R	3.0 to 3.499
S	3.5 to 4.499
T	4.5 to 5.999
U	6.0 to 8.999
V	9.0 to 13.999
W	14.0 to 24.999
X	25.0 to 49.999
Y	50.0 to 74.999
Z	75.0 to 100.0

Chip Information

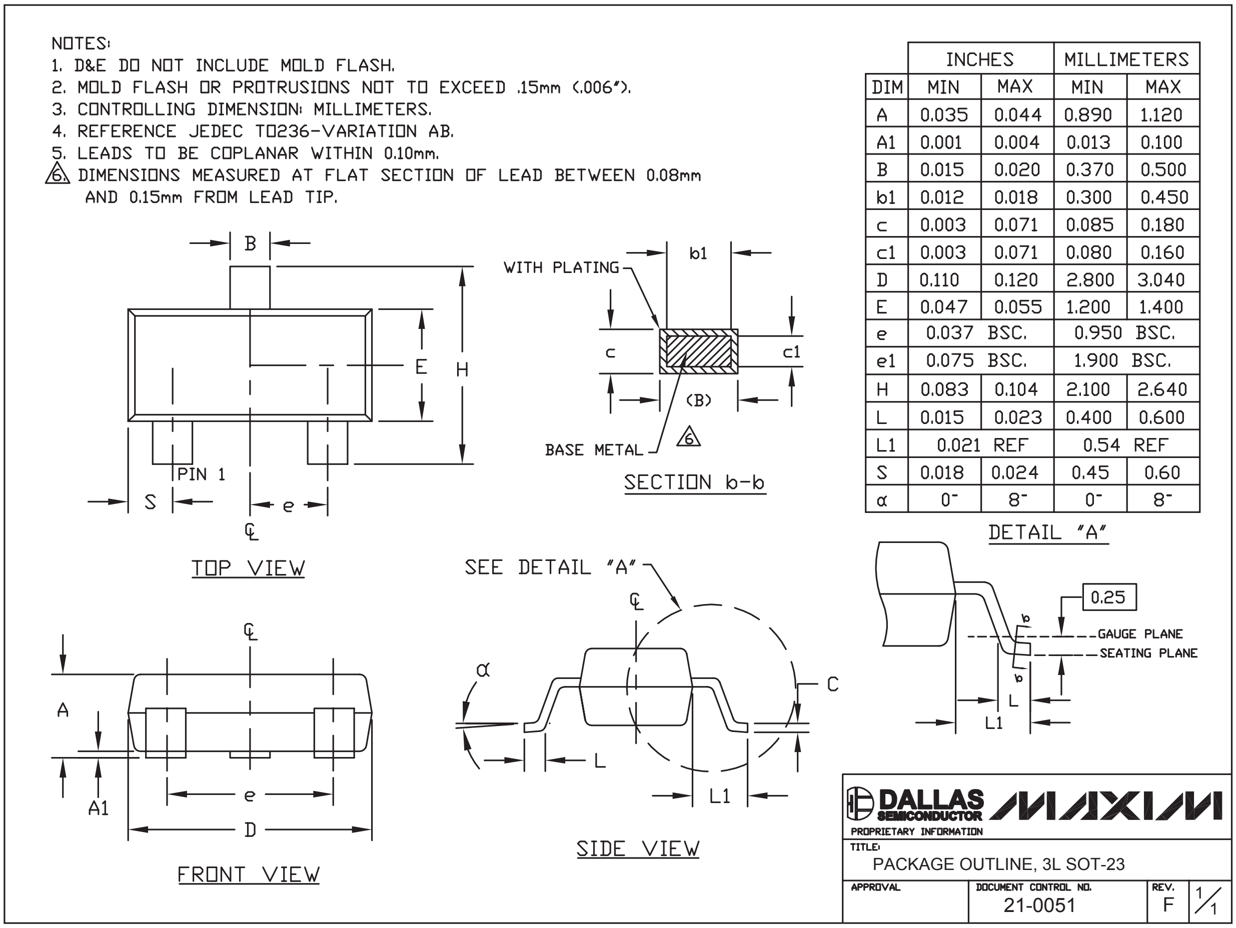
TRANSISTOR COUNT: 0

PROCESS: BiCMOS

100kΩ 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**.)



	INCHES		MILLIMETERS	
DIM	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°