19-3009; Rev 3; 12/04

Precision-Matched Resistor-Divider in SOT23

General Description

The MAX5491 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 MAX5491 includes an extremely low resistance-ratio temperature drift of 2ppm/°C over -40°C to +85°C, and has an end-to-end resistance of 30kΩ. Resistance ratios from 1:1 to 30:1 are available. Ten standard ratios are available (see Table 1), and custom ratios are also available upon request. To enhance device and system robustness, the MAX5491 also features ±2kV Human Body Model electrostatic discharge (ESD) protection to ensure against real-world ESD events. The MAX5491 is ideal for precision gain-setting applications where tight resistance matching and low temperature drift are necessary.

The MAX5491 is available in a space-saving 3-pin SOT23 package, and is guaranteed over the extended -40°C to +85°C temperature range.

Applications

Industrial Process Control

Instrumentation

Precision Gain Setting

Medical Equipment

Automatic Test Equipment

Base Stations

Features

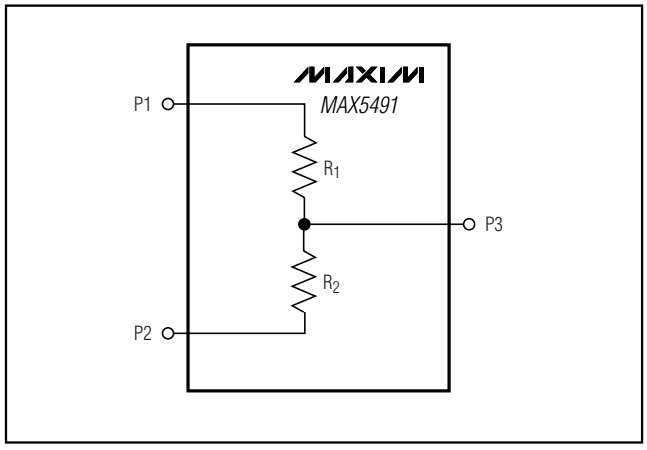
- **Resistance Ratios from 1:1 to 30:1**
- **Custom Ratios Available Upon Request**
- **±2kV Human Body Model ESD Protection**
- **Tight Initial Ratio Accuracy**
  - **0.035% (MAX5491A)**
  - **0.05% (MAX5491B)**
  - **0.1% (MAX5491C)**
- **Low 2ppm/°C Resistor-Ratio-Drift**
- **Up to 50V Operating Voltage Across Sum of R1 and R2**
- **Tiny 3-Pin SOT23 Package**

Ordering Information*

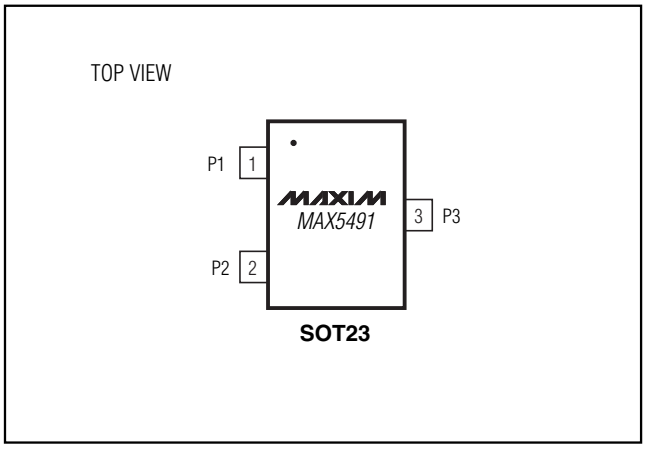
PART	TEMP RANGE	PIN-PACKAGE	RATIO ACCURACY (%)
MAX5491_A_ _ _ _ -T	-40°C to +85°C	3 SOT23-3	0.035
MAX5491_B_ _ _ _ -T	-40°C to +85°C	3 SOT23-3	0.05
MAX5491_C_ _ _ _ -T	-40°C to +85°C	3 SOT23-3	0.1

**See the How to Order section for more details.*

Block Diagram



Pin Configuration



For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

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_A = +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_A = -40°C to +85°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)		MAX5491_A, T_A = +25°C			±0.035	%
		MAX5491_B, T_A = +25°C			±0.05	
		MAX5491_C, T_A = +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 ($R_1 + R_2$)			28.5	30	31.5	kΩ
Continuous Current		I_{R1}, I_{R2}			±1.75	mA
Continuous Working Voltage Between P1 and P2	V_{P1-P2}		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_A = +25°C. Specifications over -40°C to +85°C are guaranteed by design.
Note 2: Testing conditions: T_A = +25°C, V_{P1-P2} = 9V and 50V.

Note 3: Resistance-ratio temperature coefficient is defined as $\left| \frac{\Delta\left(\frac{R_1}{R_2}\right)}{\frac{R_1}{R_2} \times \Delta T} \right|$

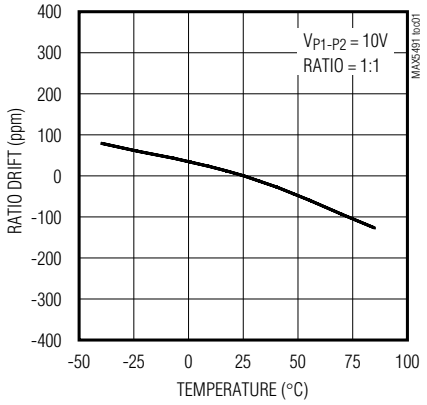
Note 4: Absolute TCR is defined as and is tested at 9V and 50V. $\left| \frac{\Delta(R_1 + R_2)}{(R_1 + R_2) \times \Delta T} \right|$

Note 5: Resistance-ratio voltage coefficient is defined as $\left| \frac{\Delta\left(\frac{R_1}{R_2}\right)}{\frac{R_1}{R_2} \times \Delta V} \right|$

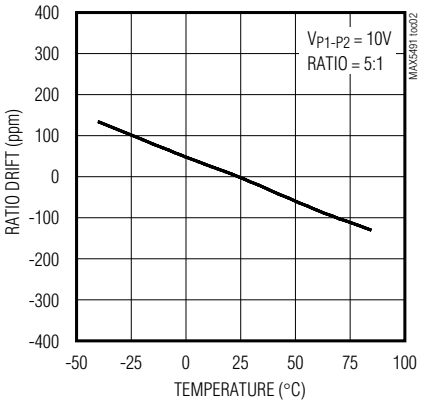
Typical Operating Characteristics

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

NORMALIZED RESISTOR-RATIO DRIFT vs. TEMPERATURE



NORMALIZED RESISTOR-RATIO DRIFT vs. TEMPERATURE



Pin Description

PIN	NAME	FUNCTION
1	P1	R_1 Connection Terminal
2	P2	R_2 Connection Terminal
3	P3	Midpoint Between R_1 and R_2 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 30kΩ (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 ±2kV ESD protection that enhances system robustness. A maximum initial ratio accuracy of 0.035% and a low 2ppm/°C ratio drift enhance system accuracy.

Precision-Matched Resistor-Divider in SOT23

Typical Applications

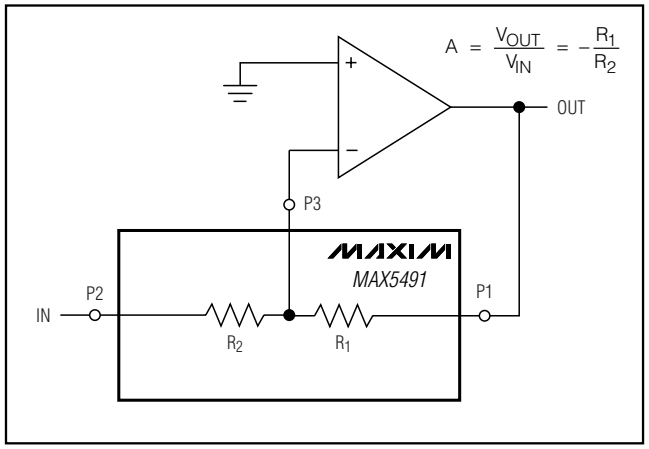


Figure 1. Inverting Amplifier Configuration

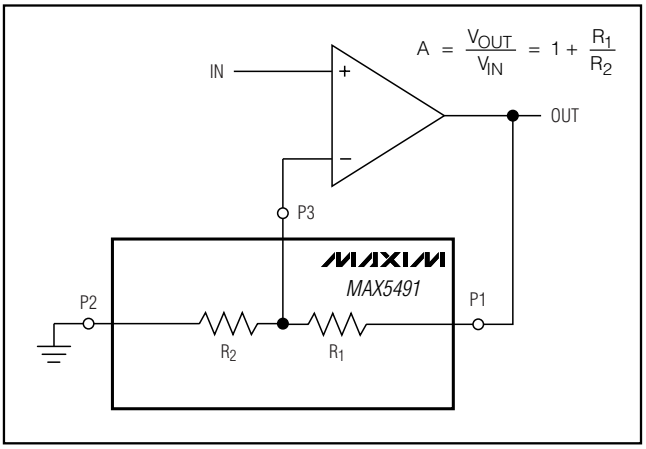


Figure 2. Noninverting Amplifier Configuration

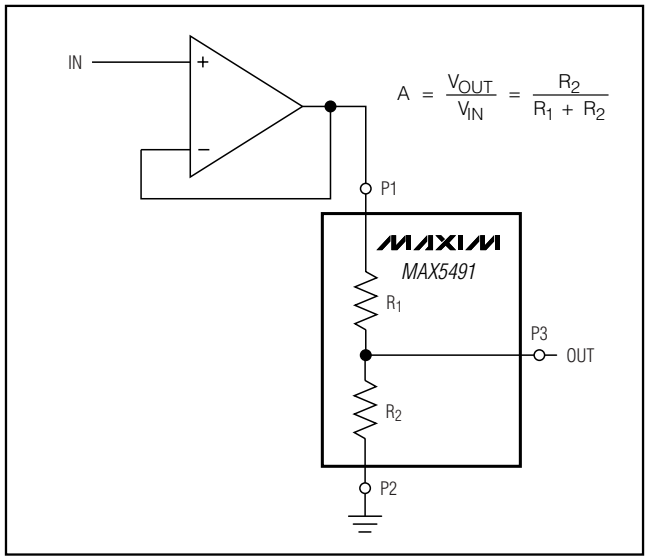


Figure 3. Buffered Attenuator

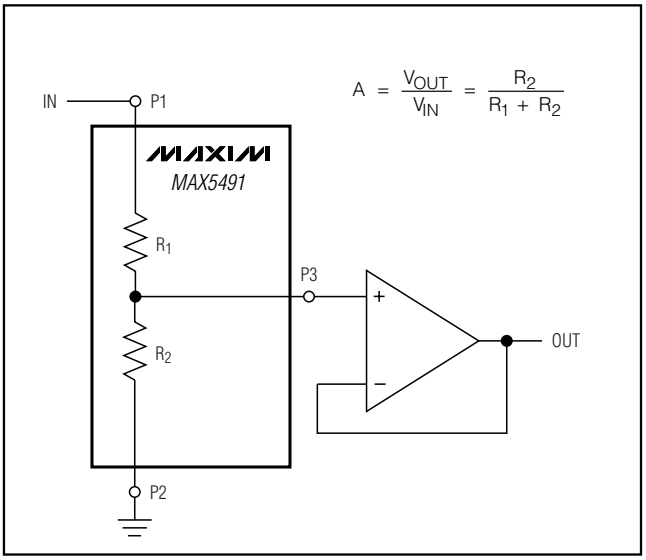


Figure 4. Attenuator with Buffer

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:

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

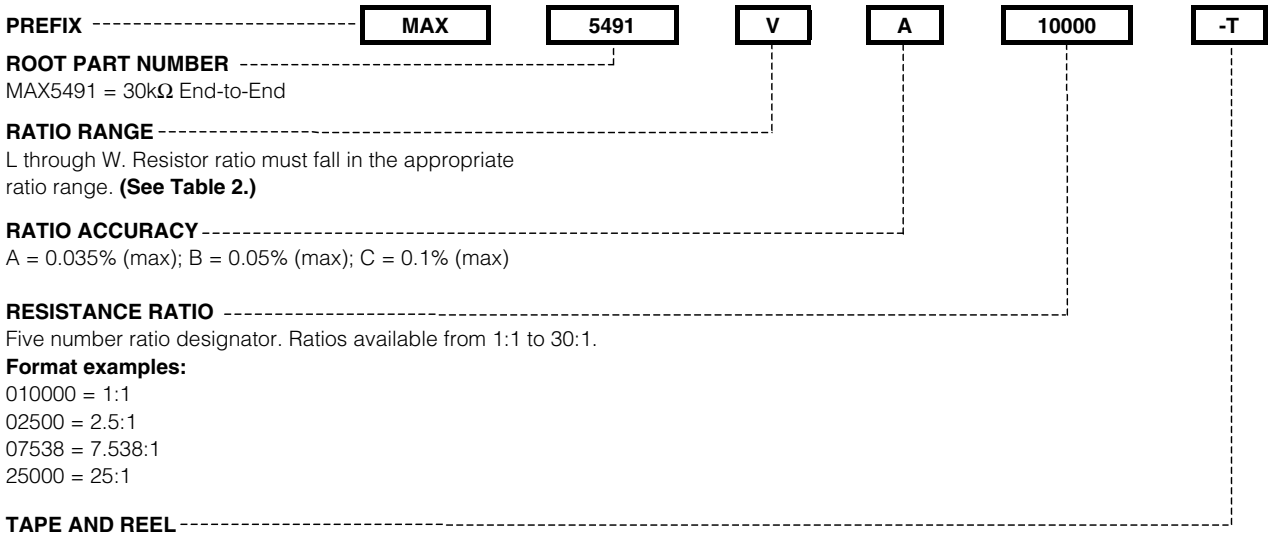
The thermal resistance from junction to ambient, θ_{J-A}, for a 3-pin SOT23 package is 141°C/W. Calculate the resulting temperature rise as:

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

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

$$11.7°C \times 2ppm/°C = 23.4ppm$$

How to Order



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

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

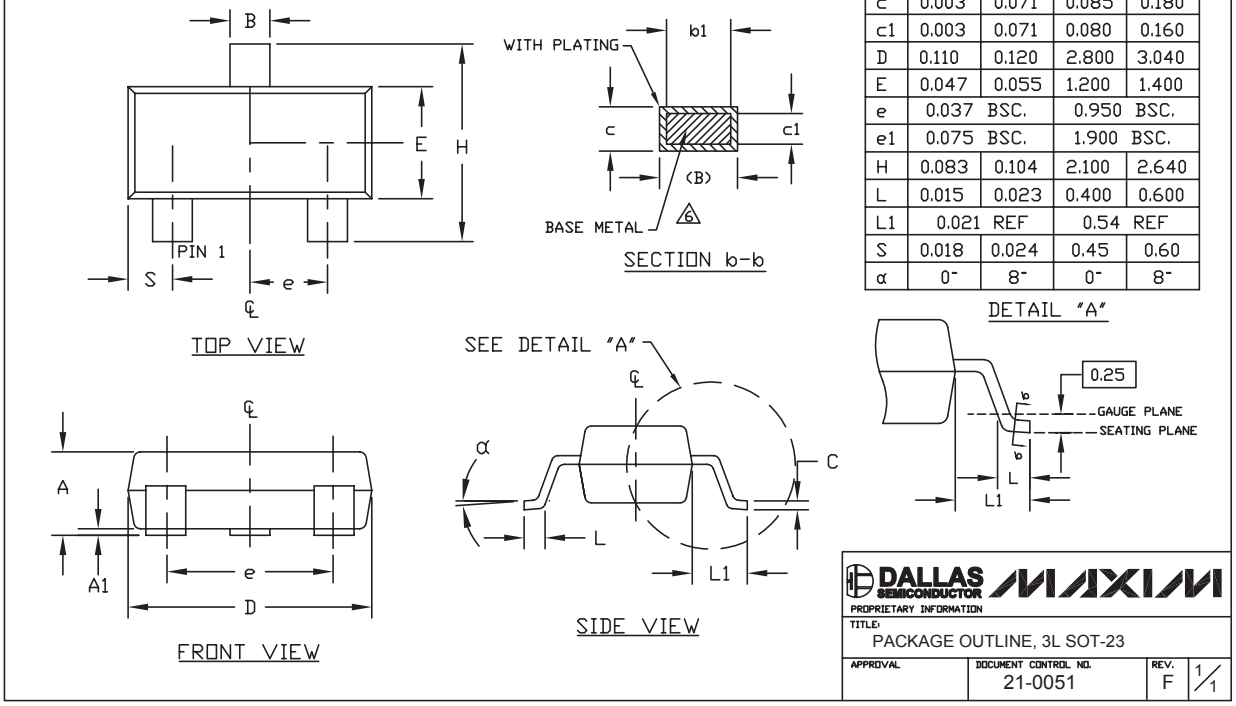
Package Information

(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**.)

SOT23 L.EPS

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.
6. DIMENSIONS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.

	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°



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