



Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail-to-Rail I/O Op Amps

General Description

The MAX4122–MAX4129 family of operational amplifiers combines wide bandwidth and excellent DC accuracy with Rail-to-Rail® operation at the inputs and outputs. These devices require only 650µA per amplifier, and operate from either a single supply (+2.7V to +6.5V) or dual supplies ($\pm 1.35V$ to $\pm 3.25V$) with a common-mode voltage range that extends 250mV beyond V_{EE} and V_{CC} . They are capable of driving 250Ω loads. The MAX4122/MAX4123/MAX4126/MAX4127/MAX4129 have a 5MHz gain bandwidth product, while the decompensated MAX4124/MAX4125/MAX4128 (stable at closed-loop gains of 10 or greater) have a 25MHz gain bandwidth product. In addition, the MAX4123/MAX4125/MAX4127 feature a shutdown mode in which the outputs are placed in a high-impedance state and the supply current is reduced to only 25µA per amplifier.

With their rail-to-rail input common-mode range and output swing, these amplifiers are ideal for low-voltage single-supply operation. Although the minimum operating voltage is specified at 2.7V, the devices typically operate down to 1.8V. In addition, low offset voltage and high speed make them the ideal signal-conditioning stages for precision, low-voltage, data-acquisition systems. **The MAX4122 and MAX4124 come in the space-saving 5-pin SOT23-5 package.**

Applications

Battery-Powered Instruments
 Portable Equipment
 Data-Acquisition Systems
 Signal Conditioning
 Low-Power, Low-Voltage Applications

Selection Table

PART	BW (MHz)	AMPS PER PKG.	SHUT-DOWN MODE	PIN-PACKAGE
MAX4122	5	1	—	5 SOT23-5
MAX4123	5	1	Yes	8 SO/µMAX
MAX4124	25	1	—	5 SOT23-5
MAX4125	25	1	Yes	8 SO/µMAX
MAX4126	5	2	—	8 SO/µMAX
MAX4127	5	2	Yes	14 SO
MAX4128	25	2	—	8 SO/µMAX
MAX4129	5	4	—	14 SO

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

Features

- ◆ 5-Pin SOT23 Package (MAX4122/4)
- ◆ +2.7V to +6.5V Single-Supply Operation
- ◆ Rail-to-Rail Input Common-Mode Voltage Range
- ◆ Rail-to-Rail Output Voltage Swing
- ◆ 5MHz Gain-Bandwidth Product (MAX4122/3/6/7/9)
25MHz Gain-Bandwidth Product (MAX4124/5/8)
- ◆ 650µA Quiescent Current per Amplifier
- ◆ 25µA Shutdown Function (MAX4123/5/7)
- ◆ 200µV Offset Voltage
- ◆ No Phase Reversal for Overdriven Inputs
- ◆ Drive 250Ω Loads
- ◆ Stable with 500pF Capacitive Loads
- ◆ Unity-Gain Stable (MAX4122/3/6/7/9)
Stable at Gains $\geq 10V/V$ (MAX4124/5/8)

Ordering Information

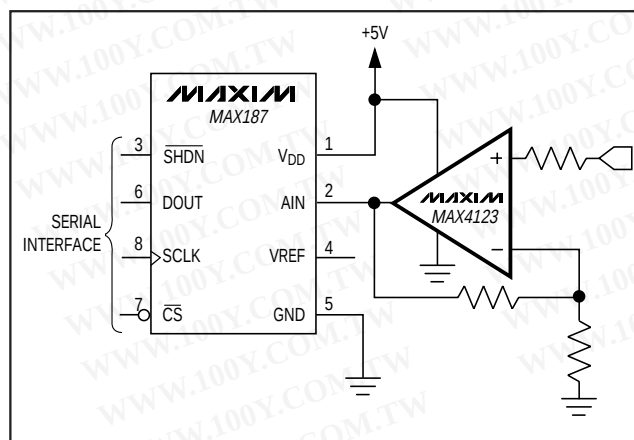
PART	TEMP. RANGE	PIN-PACKAGE	MARKING INFO.
MAX4122EUK	-40°C to +85°C	5 SOT23-5	AAAZ
MAX4123C/D	0°C to +70°C	Dice*	—
MAX4123ESA	-40°C to +85°C	8 SO	—
MAX4123EUA	-40°C to +85°C	8 µMAX	—

Ordering Information continued at end of data sheet.

*Dice are specified at $T_A = +25^\circ\text{C}$, DC parameters only.

Pin Configurations appear at end of data sheet.

Typical Operating Circuit



Maxim Integrated Products 1

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 For small orders, phone 408-737-7600 ext. 3468.

MAX4122–MAX4129

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ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC} - V_{EE}) 7.5V
 IN+, IN-, $\overline{SHDN}$ Voltage ($V_{CC} + 0.3V$) to ($V_{EE} - 0.3V$)
 Output Short-Circuit Duration (Note 1) Continuous
 (short to either supply)
 Continuous Power Dissipation ($T_A = +70^\circ C$)
 5-pin SOT23-5 (derate 7.1mW/ $^\circ C$ above $+70^\circ C$) 571mW
 8-pin SO (derate 5.88mW/ $^\circ C$ above $+70^\circ C$) 471mW
 8-pin μ MAX (derate 4.10mW/ $^\circ C$ above $+70^\circ C$) 330mW
 14-pin SO (derate 8.00mW/ $^\circ C$ above $+70^\circ C$) 640mW

Operating Temperature Range

MAX412_E $-40^\circ C$ to $+85^\circ C$

Maximum Junction Temperature $+150^\circ C$

Storage Temperature Range $-65^\circ C$ to $+160^\circ C$

Lead Temperature (soldering, 10sec) $+300^\circ C$

Note 1: Provided that the maximum package power-dissipation rating is met.

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

($V_{CC} = +2.7V$ to $+6.5V$, $V_{EE} = 0V$, $V_{CM} = 0V$, $V_{OUT} = V_{CC}/2$, R_L tied to $V_{CC}/2$, $\overline{SHDN} \geq 2V$ (or open), $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Input Offset Voltage	$V_{CM} = V_{EE}$ to V_{CC}	MAX4123ESA/MAX4125ESA		± 0.20	± 0.60	mV
		MAX4122EUK/MAX4124EUK		± 0.35	± 1.50	
		MAX4123EUA/MAX4125EUA		± 0.35	± 1.20	
		MAX4126ESA/MAX4127ESD/MAX4128ESA		± 0.25	± 0.75	
		MAX4126EUA/MAX4128EUA		± 0.40	± 1.50	
		MAX4129ESD		± 0.35	± 1.50	
Input Bias Current	$V_{CM} = V_{EE}$ to V_{CC}			± 50	± 150	nA
Input Offset Current	$V_{CM} = V_{EE}$ to V_{CC}			± 1	± 12	nA
Differential Input Resistance	$-1.5V < V_{DIFF} < 1.5V$			500		k Ω
Common-Mode Input Voltage Range			$V_{EE} - 0.25$		$V_{CC} + 0.25$	V
Common-Mode Rejection Ratio	$(V_{EE} - 0.25) < V_{CM} < (V_{CC} + 0.25V)$	MAX4123ESA/MAX4125ESA	78	98		dB
		MAX4122EUK/MAX4124EUK	67	90		
		MAX4123EUA/MAX4125EUA	68	88		
		MAX4126ESA/MAX4127ESD/MAX4128ESA	74	94		
		MAX4126EUA/MAX4128EUA	66	86		
		MAX4129ESD	64	84		
Power-Supply Rejection Ratio	$V_{CC} = 2.7V$ to $6.5V$		78	100		dB
Output Resistance	$A_V = 1$			0.1		Ω
Off-Leakage Current	$\overline{SHDN} < 0.8V$, $V_{OUT} = 0V$ to V_{CC}			± 0.1	± 1	μA
Large-Signal Voltage Gain	$V_{CC} = 2.7V$	$V_{OUT} = 0.25V$ to $2.45V$, $R_L = 100k\Omega$	92	104		dB
		$V_{OUT} = 0.4V$ to $2.3V$, $R_L = 250\Omega$	72	80		
	$V_{CC} = 5V$	$V_{OUT} = 0.25V$ to $4.75V$, $R_L = 100k\Omega$	94	106		
		$V_{OUT} = 0.4V$ to $4.6V$, $R_L = 250\Omega$	75	84		

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DC ELECTRICAL CHARACTERISTICS (continued)

($V_{CC} = +2.7V$ to $+6.5V$, $V_{EE} = 0V$, $V_{CM} = 0V$, $V_{OUT} = V_{CC}/2$, R_L tied to $V_{CC}/2$, $\overline{SHDN} \geq 2V$ (or open), $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Output Voltage Swing	MAX4122/ MAX4123/ MAX4124/ MAX4125	R _L = 100kΩ	V _{CC} - V _{OH}		12	20	mV
			V _{OL} - V _{EE}		20	35	
		R _L = 250Ω	V _{CC} - V _{OH}		240	290	
			V _{OL} - V _{EE}		125	170	
	MAX4126/ MAX4127/ MAX4128/ MAX4129	R _L = 100kΩ	V _{CC} - V _{OH}		15	30	
			V _{OL} - V _{EE}		25	40	
		R _L = 250Ω	V _{CC} - V _{OH}		280	330	
			V _{OL} - V _{EE}		180	230	
Output Short-Circuit Current					50		mA
$\overline{\text{SHDN}}$ Logic Threshold	MAX4123/MAX4125/MAX4127		Low			0.8	V
			High	2.0			
$\overline{\text{SHDN}}$ Input Current	MAX4123/MAX4125/MAX4127				±1	±3	μA
Operating Supply-Voltage Range				2.7		6.5	V
Supply Current per Amplifier	V _{CM} = V _{OUT} = V _{CC} /2		V _{CC} = 2.7V		650	750	μA
			V _{CC} = 5V		725	825	
Shutdown Supply Current per Amplifier	$\overline{\text{SHDN}}$ > 0.8V, MAX4123/MAX4125/MAX4127		V _{CC} = 2.7V		25	40	μA
			V _{CC} = 5V		40	60	

DC ELECTRICAL CHARACTERISTICS

($V_{CC} = +2.7V$ to $+6.5V$, $V_{EE} = 0V$, $V_{CM} = 0V$, $V_{OUT} = V_{CC}/2$, R_L tied to $V_{CC}/2$, $\overline{SHDN} \geq 2V$ (or open), $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise noted.)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Input Offset Voltage	$V_{CM} =$ V_{EE} to V_{CC}	MAX4123ESA/MAX4125ESA				± 0.75	mV
		MAX4122EUK/MAX4124EUK				± 3.50	
		MAX4123EUA/MAX4125EUA				± 4.40	
		MAX4126ESA/MAX4127ESD/MAX4128ESA				± 0.95	
		MAX4126EUA/MAX4128EUA				± 4.70	
		MAX4129ESD				± 4.00	
Input Offset Voltage Tempco					± 2		$\mu V/^\circ C$
Input Bias Current	$V_{CM} = V_{EE}$ to V_{CC}					± 160	nA
Input Offset Current	$V_{CM} = V_{EE}$ to V_{CC}					± 18	nA
Common-Mode Input Voltage Range				$V_{EE} - 0.20$		$V_{CC} + 0.20$	V
Common-Mode Rejection Ratio	$(V_{EE} - 0.2V) <$ $V_{CM} <$ $(V_{CC} + 0.2V)$	MAX4123ESA/MAX4125ESA		76			dB
		MAX4122EUK/MAX4124EUK		62			
		MAX4123EUA/MAX4125EUA		60			
		MAX4126ESA/MAX4127ESD/MAX4128ESA		74			
		MAX4126EUA/MAX4128EUA		58			
		MAX4129ESD		60			

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DC ELECTRICAL CHARACTERISTICS (continued)

($V_{CC} = +2.7V$ to $+6.5V$, $V_{EE} = 0V$, $V_{CM} = 0V$, $V_{OUT} = V_{CC}/2$, R_L tied to $V_{CC}/2$, $\overline{SHDN} \geq 2V$ (or open), $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise noted.)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Power-Supply Rejection Ratio	V _{CC} = 2.7V to 6.5V			74			dB
Off-Leakage Current	SHDN $\overline{}$ < 0.8V, V _{OUT} = 0V to V _{CC}					±12	μA
Large-Signal Voltage Gain	V _{CC} = 2.7V	V _{OUT} = 0.25V to 2.45V, R _L = 100kΩ		84			dB
		V _{OUT} = 0.4V to 2.3V, R _L = 250Ω		66			
	V _{CC} = 5V	V _{OUT} = 0.25V to 4.75V, R _L = 100kΩ		86			
		V _{OUT} = 0.4V to 4.6V, R _L = 250Ω		68			
Output Voltage Swing	MAX4122/ MAX4123/ MAX4124/ MAX4125	R _L = 100kΩ	V _{CC} - V _{OH}			25	mV
			V _{OL} - V _{EE}			40	
		R _L = 250Ω	V _{CC} - V _{OH}			300	
			V _{OL} - V _{EE}			190	
	MAX4126/ MAX4127/ MAX4128/ MAX4129	R _L = 100kΩ	V _{CC} - V _{OH}			35	
			V _{OL} - V _{EE}			50	
		R _L = 250Ω	V _{CC} - V _{OH}			350	
			V _{OL} - V _{EE}			250	
SHDN Logic Threshold	MAX4123/MAX4125/MAX4127		Low			0.8	V
			High	2.0			
SHDN Input Current	MAX4123/MAX4125/MAX4127					±3	μA
Operating Supply-Voltage Range				2.7		6.5	V
Supply Current per Amplifier	V _{CM} = V _{OUT} = V _{CC} /2		V _{CC} = 2.7V			775	μA
			V _{CC} = 5V			850	
Shutdown Supply Current per Amplifier	SHDN $\overline{}$ < 0.8V, MAX4123/MAX4125/MAX4127		V _{CC} = 2.7V			50	μA
			V _{CC} = 5V			70	

AC ELECTRICAL CHARACTERISTICS

($V_{CC} = +2.7V$ to $+6.5V$, $V_{EE} = 0V$, $\overline{SHDN} \geq 2V$ (or open), $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Gain-Bandwidth Product	MAX4122/23/26/27/29		5		MHz
	MAX4124/25/28 ($A_V \geq 10$)		25		
Phase Margin	MAX4122/23/26/27/29		64		degrees
	MAX4124/25/28 ($A_V \geq 10$)		60		
Gain Margin	MAX4122/23/26/27/29		12		dB
	MAX4124/25/28 ($A_V \geq 10$)		10		
Total Harmonic Distortion	$f = 10kHz$, $V_{OUT} = 2V_{p-p}$, MAX4122/23/26/27/29 ($A_V = 1$)		0.003		%
Slew Rate	MAX4122/23/26/27/29		2		V/ μs
	MAX4124/25/28 ($A_V \geq 10$)		10		
Settling Time to 0.01%	MAX4122/23/26/27/29 ($A_V = 1$), $V_{OUT} = 2V$ step		2.0		μs
	MAX4124/25/28 ($A_V \geq 10$), $V_{OUT} = 2V$ step		1.3		
Turn-On Time	$V_{CC} = 0V$ to $3V$ step, $V_{OUT} = V_{CC}/2$		1		μs

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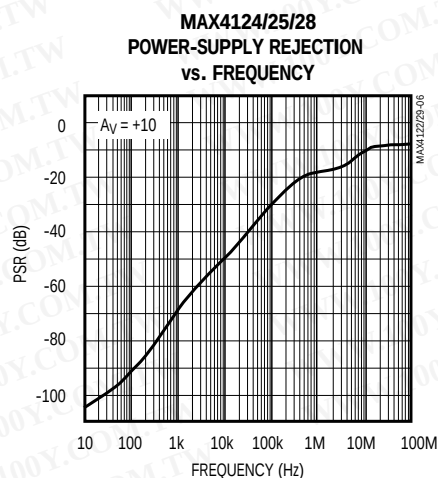
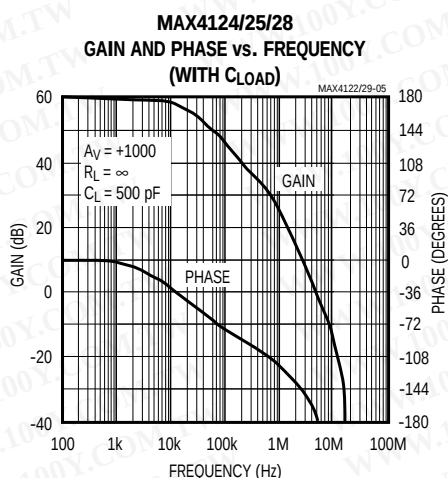
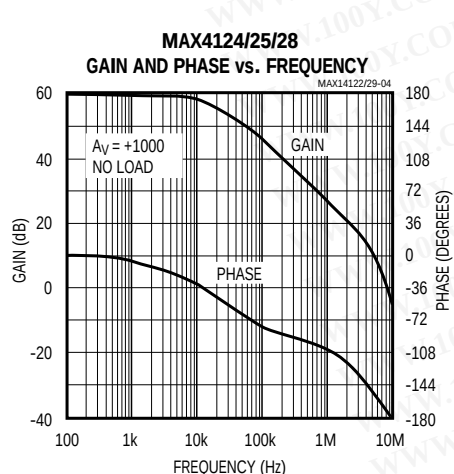
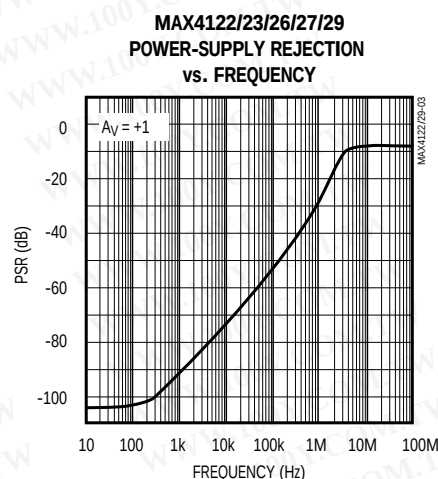
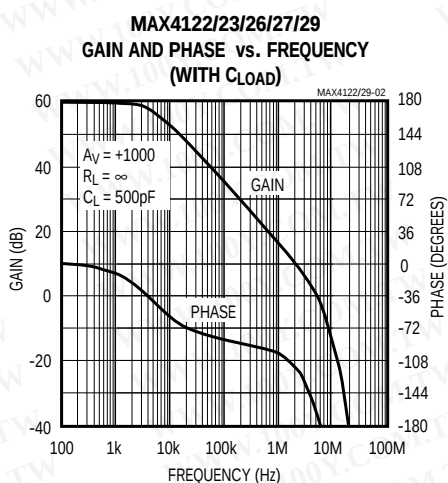
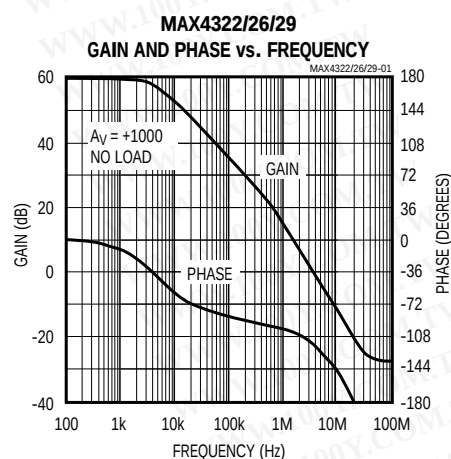
AC ELECTRICAL CHARACTERISTICS (continued)

($V_{CC} = +2.7V$ to $+6.5V$, $V_{EE} = 0V$, $\overline{SHDN} \geq 2V$ (or open), $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$\overline{SHDN}$ Delay	$V_{CC} = 3V$, $V_{OUT} = V_{CC}/2$, MAX4123/25/27	Enable		1		μs
		Disable		0.2		
Input Capacitance				3		pF
Input Noise Voltage Density	$f = 1kHz$			22		$nV/\sqrt{Hz}$
Input Noise Current Density	$f = 1kHz$			0.4		$pA/\sqrt{Hz}$
Amp-Amp Isolation	MAX4126/27/28/29			135		dB
Capacitive Load Stability	MAX4122/23/26/27/29 ($A_V = 1$)			500		pF
	MAX4124/25/28 ($A_V \geq 10$)			500		

Typical Operating Characteristics

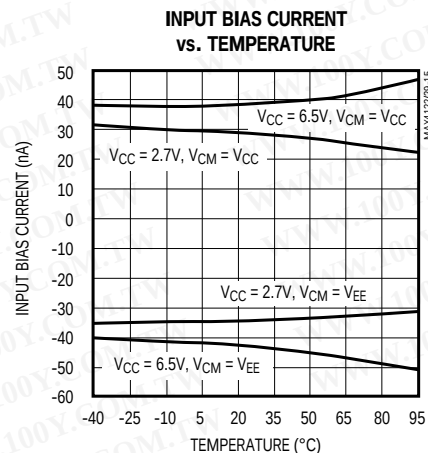
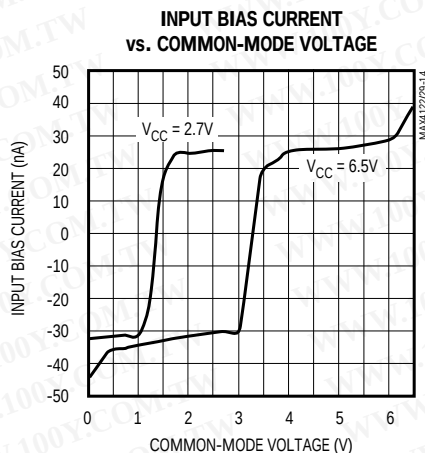
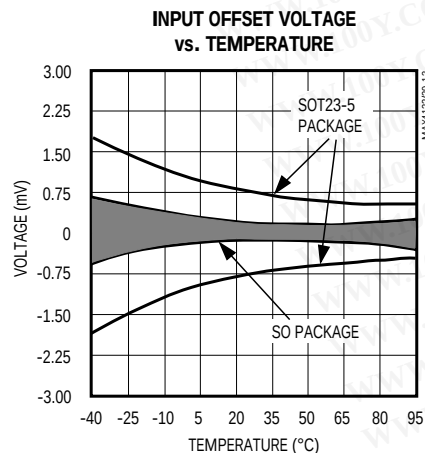
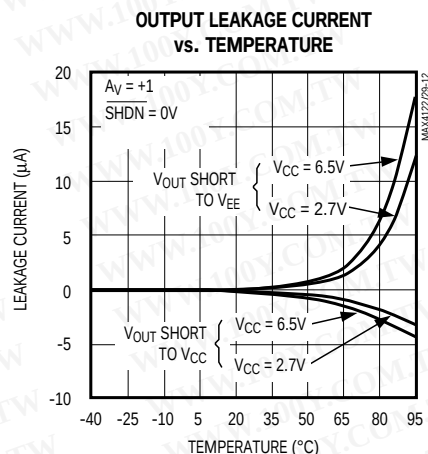
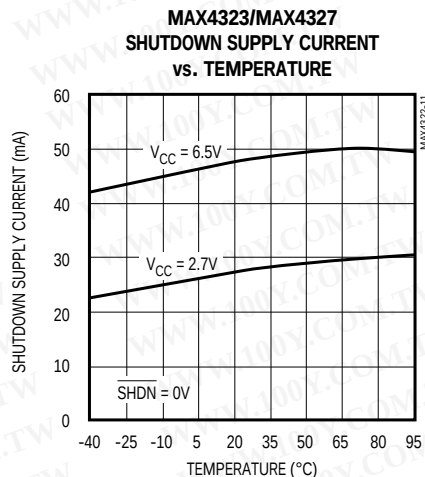
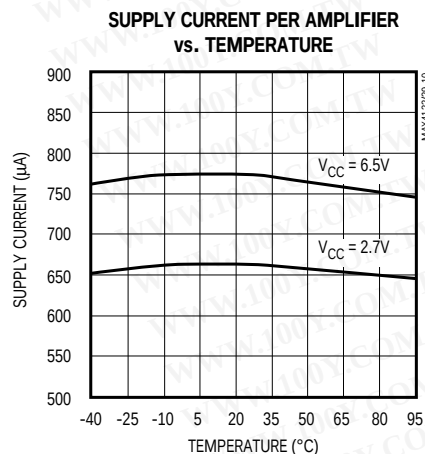
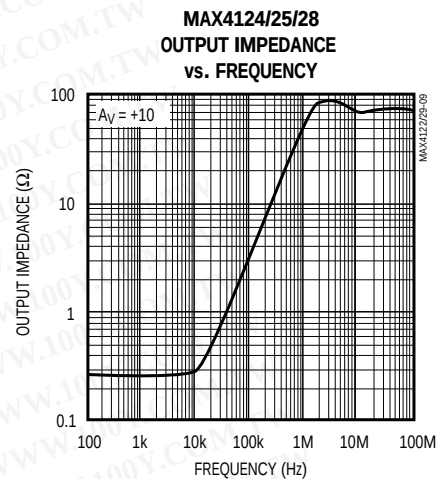
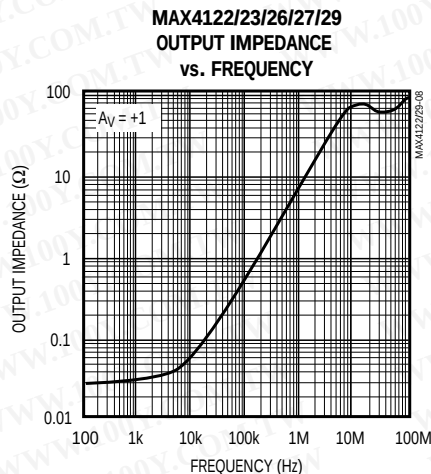
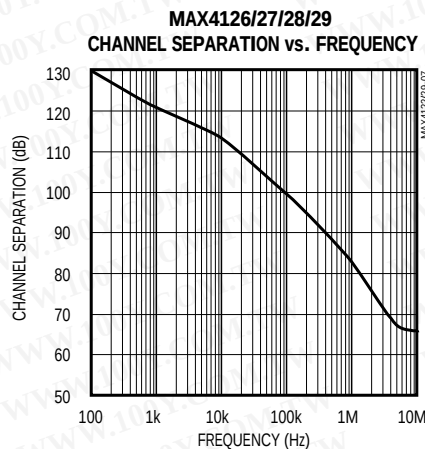
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Typical Operating Characteristics (continued)

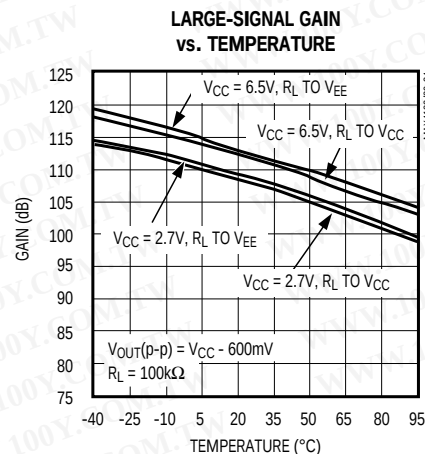
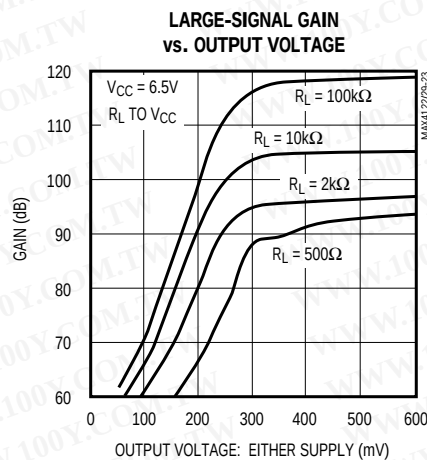
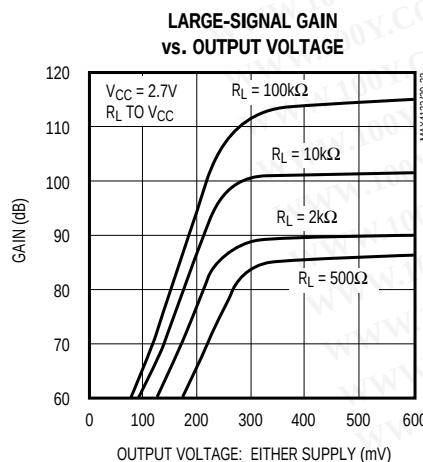
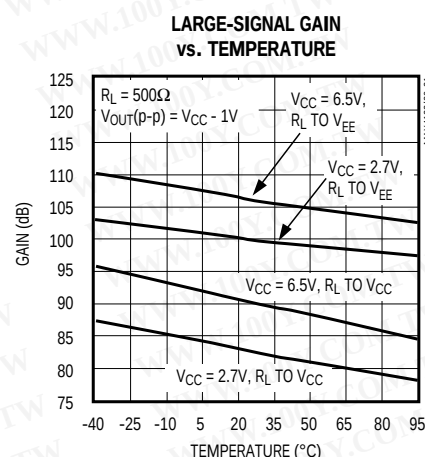
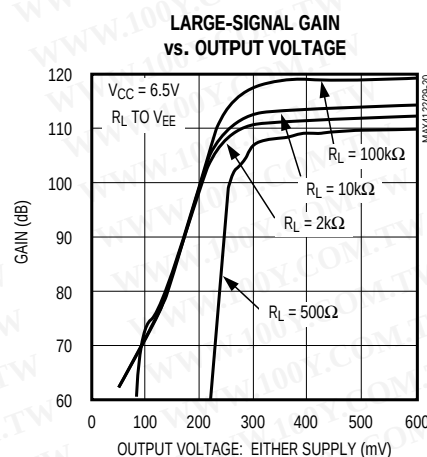
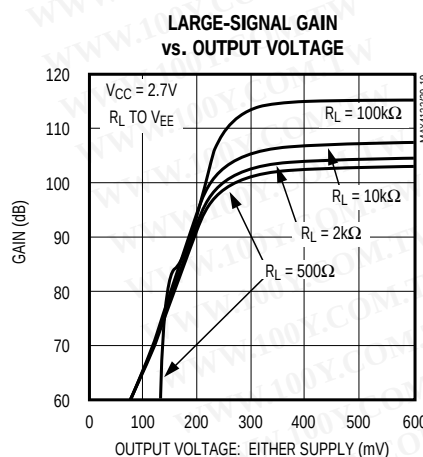
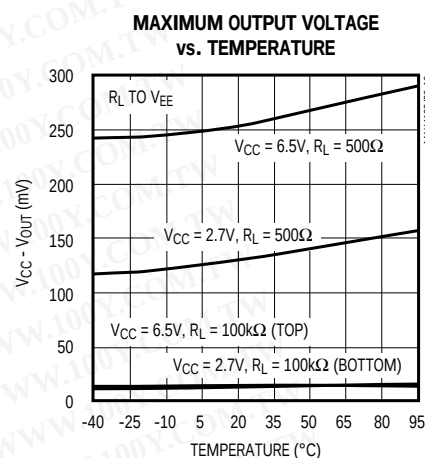
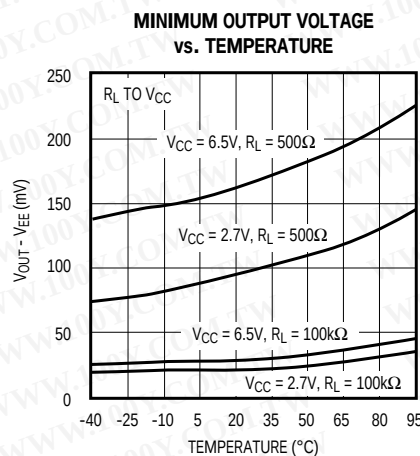
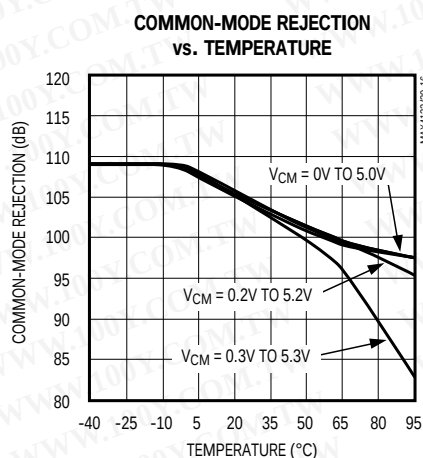
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Typical Operating Characteristics (continued)

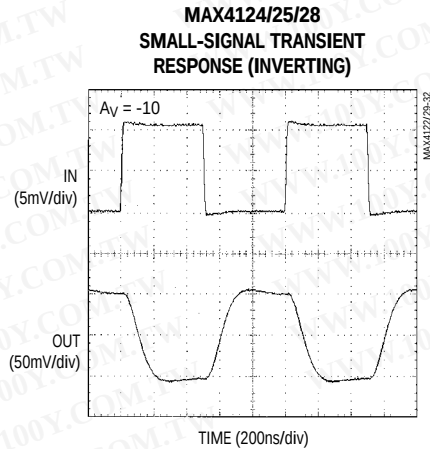
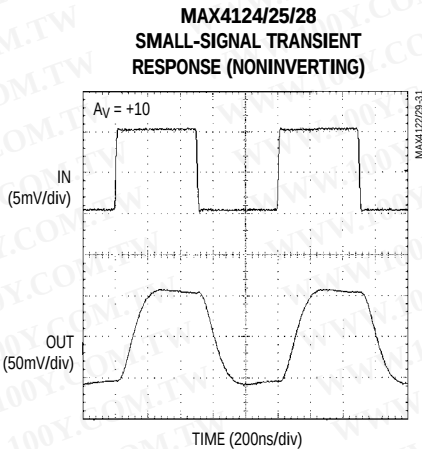
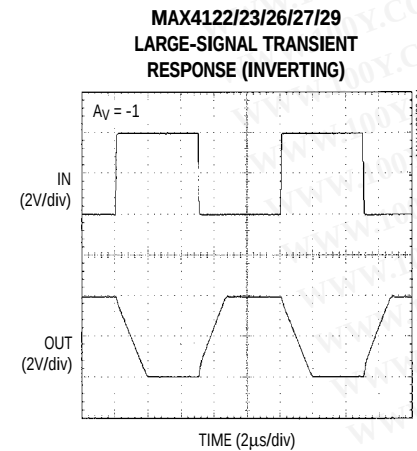
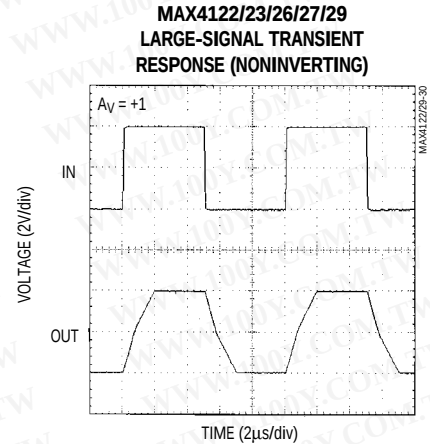
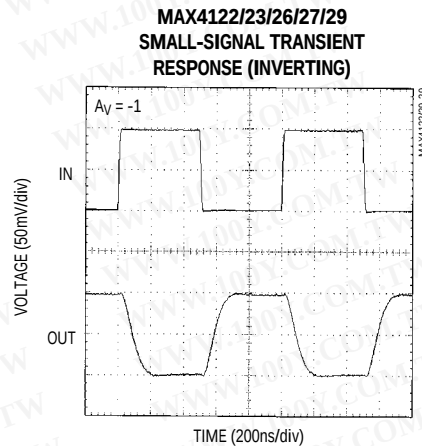
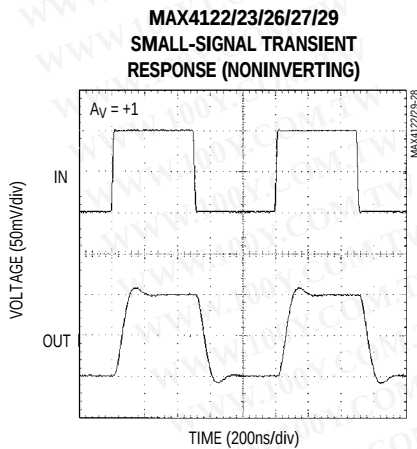
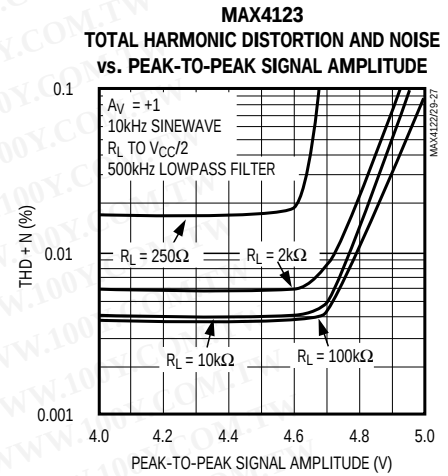
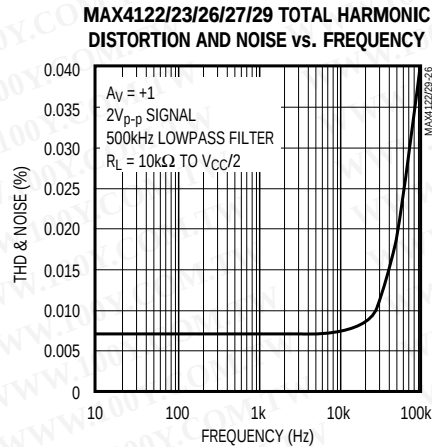
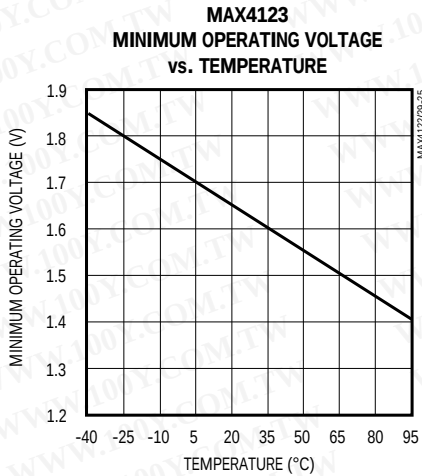
($V_{CC} = +5V$, $V_{EE} = 0V$, $V_{CM} = V_{CC}/2$, $T_A = +25^\circ C$, unless otherwise noted.)



Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail-to-Rail I/O Op Amps

Typical Operating Characteristics (continued)

($V_{CC} = +5V$, $V_{EE} = 0V$, $V_{CM} = V_{CC}/2$, $T_A = +25^\circ C$, unless otherwise noted.)



Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply

Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail

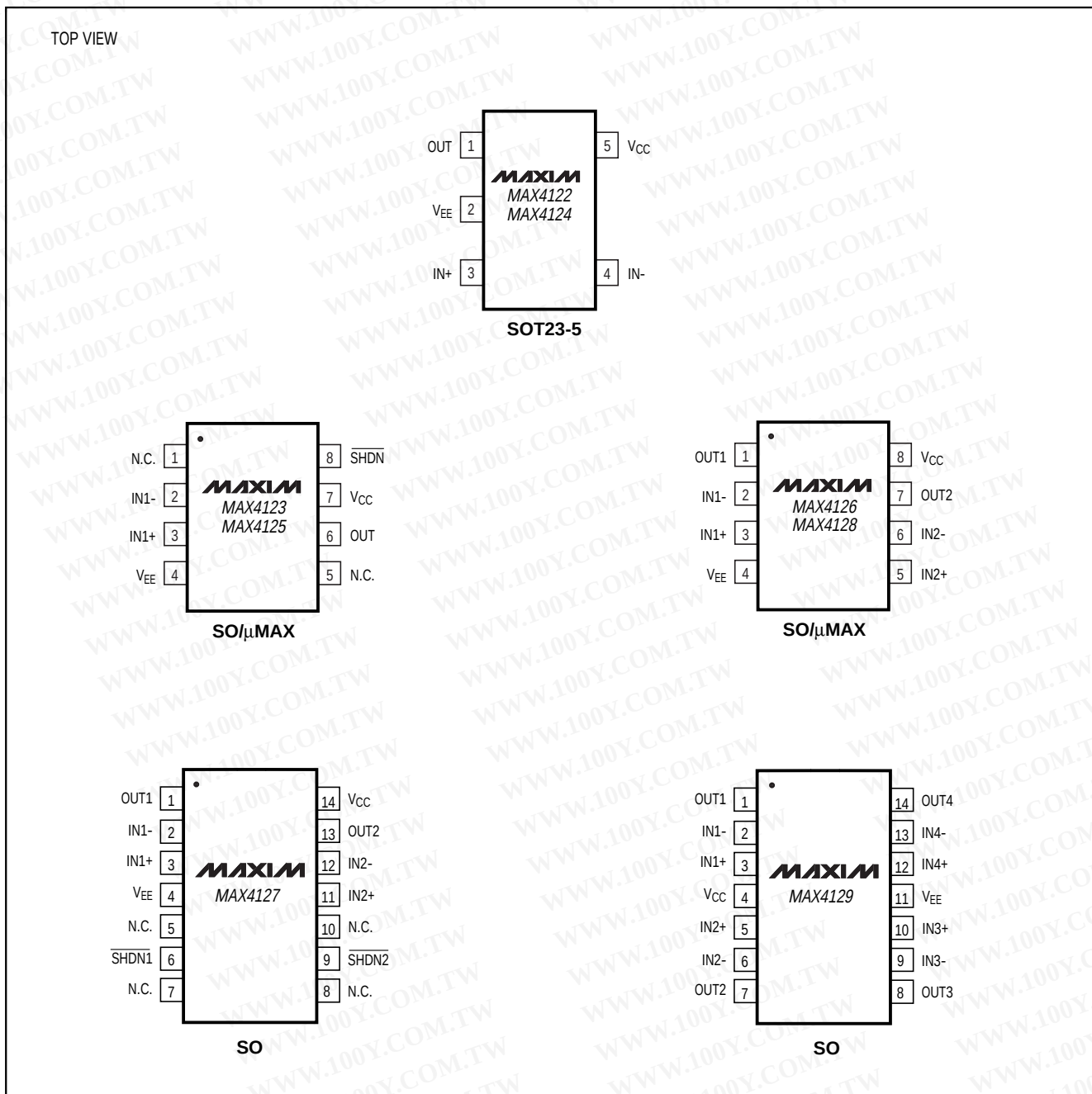
Single/Dual/Quad, Wide-Bandwidth, Low

Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail

Single/Dual/Quad,

Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail-to-Rail I/O Op Amps

Pin Configurations



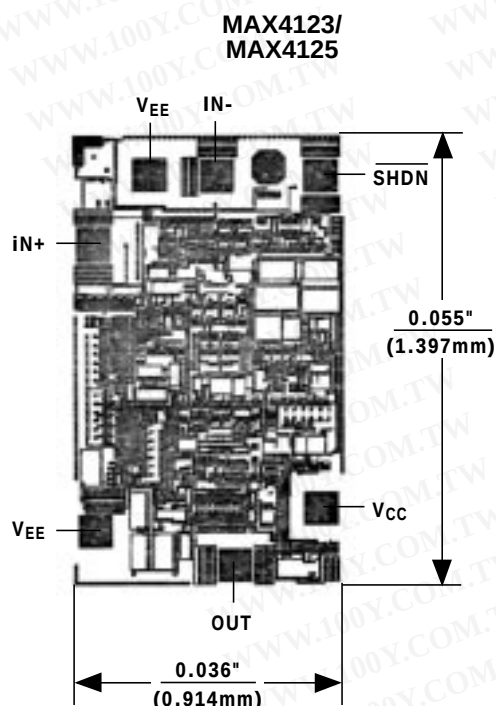
Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail-to-Rail I/O Op Amps

Ordering Information (continued)

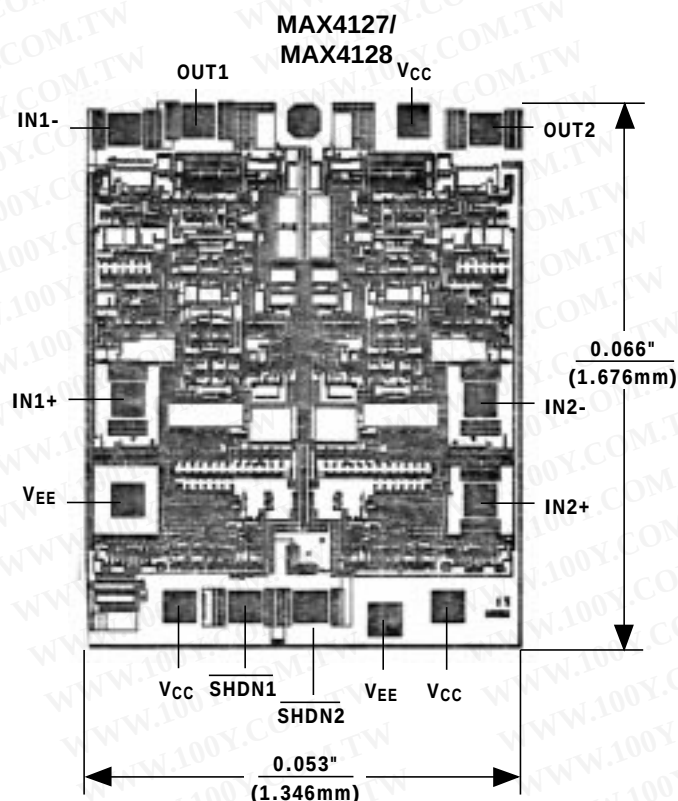
PART	TEMP. RANGE	PIN-PACKAGE	MARKING INFO.
MAX4124EUK	-40°C to +85°C	5 SOT23-5	AABA
MAX4125ESA	-40°C to +85°C	8 SO	—
MAX4125EUA	-40°C to +85°C	8 μ MAX	—
MAX4126ESA	-40°C to +85°C	8 SO	—
MAX4126EUA	-40°C to +85°C	8 μ MAX	—
MAX4127C/D	0°C to +70°C	Dice*	—
MAX4127ESD	-40°C to +85°C	14 SO	—
MAX4128ESA	-40°C to +85°C	8 SO	—
MAX4128EUA	-40°C to +85°C	8 μ MAX	—
MAX4129ESD	-40°C to +85°C	14 SO	—

*Dice are specified at $T_A = +25^\circ\text{C}$, DC parameters only.

Chip Topographies



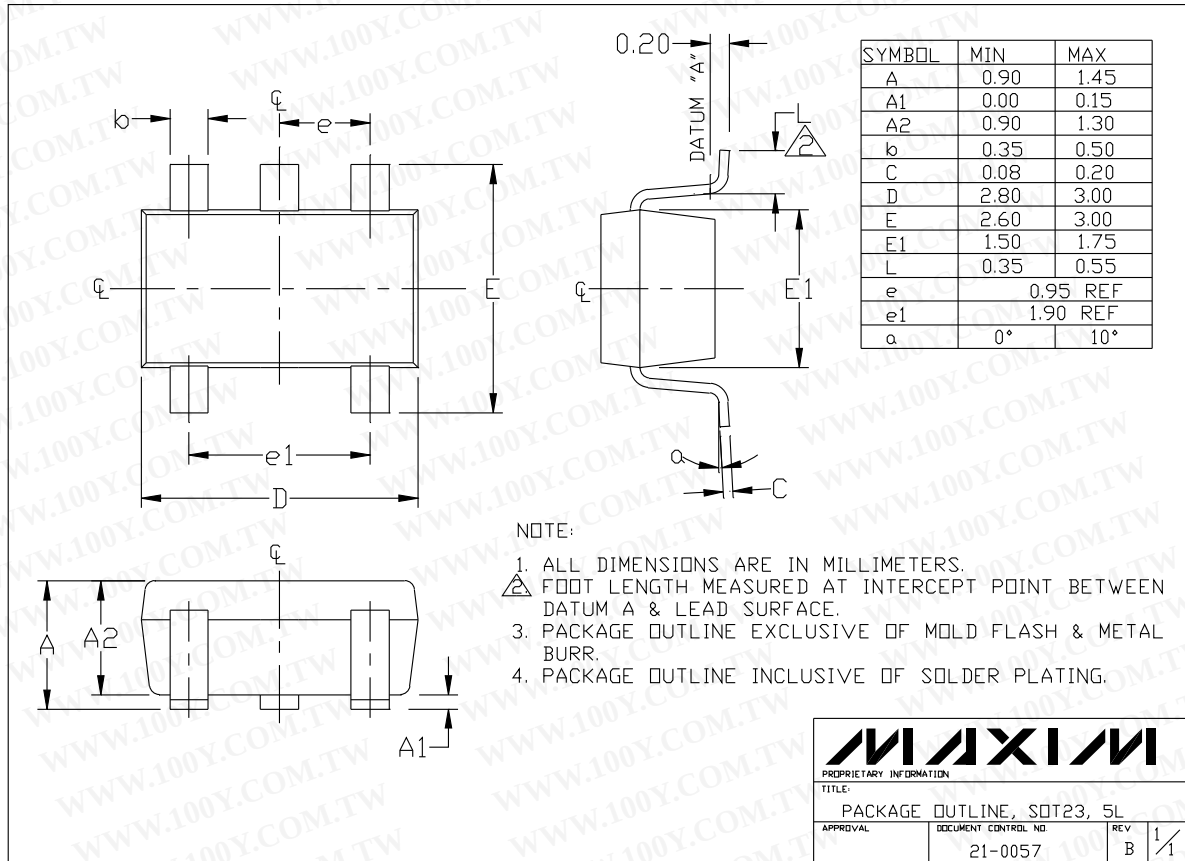
TRANSISTOR COUNT: 170
SUBSTRATE CONNECTED TO VEE



TRANSISTOR COUNT: 340
SUBSTRATE CONNECTED TO VEE

Single/Dual/Quad, Wide-Bandwidth, Low-Power, Single-Supply Rail-to-Rail I/O Op Amps

Package Information



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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