19-2021; Rev 2; 2/03

MAXIM

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

General Description

The MAX4464/MAX4470/MAX4471/MAX4472/MAX4474 family of micropower op amps operate from a single +1.8V to +5.5V supply and draw only 750nA of supply current. The MAX4470 family feature ground-sensing inputs and Rail-to-Rail® output. The ultra-low supply current, low-operating voltage, and rail-to-rail output capabilities make these operational amplifiers ideal for use in single lithium ion (Li+), or two-cell NiCd or alkaline battery systems.

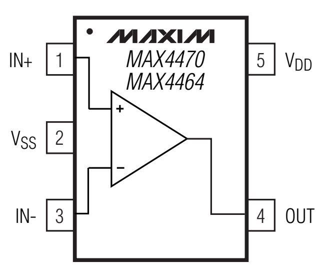
The rail-to-rail output stage of the MAX4464/MAX4470/MAX4471/MAX4472/MAX4474 amplifiers is capable of driving the output voltage to within 4mV of the rail with a 100kΩ load, and can sink and source 11mA with a +5V supply. These amplifiers are available in both fully compensated and decompensated versions. The single MAX4470, dual MAX4471, and the quad MAX4472 are unity-gain stable. The single MAX4464 and the dual MAX4474 are stable for closed-loop gain configurations of ≥ +5V/V. These amplifiers are available in space-saving SC70, SOT23, μMAX, and TSSOP packages.

Applications

- Battery-Powered Systems
- Portable Instrumentation
- Pagers and Cellphones
- Micropower Thermostats
- Electrometer Amplifiers
- Solar-Powered Systems
- Remote Sensor Active Badges
- pH Meters

Pin Configurations

TOP VIEW



SC70/SOT23

Pin Configurations continued at end of data sheet.

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

Features

- ♦ Ultra-Low 750nA Supply Current Per Amplifier
- ♦ Ultra-Low +1.8V Supply Voltage Operation
- ♦ Ground-Sensing Input Common-Mode Range
- ♦ Outputs Swing Rail-to-Rail
- ♦ Outputs Source and Sink 11mA of Load Current
- ♦ No Phase Reversal for Overdriven Inputs
- ♦ High 120dB Open-Loop Voltage Gain
- ♦ Low 500μV Input Offset Voltage
- ♦ 9kHz Gain-Bandwidth Product (MAX4470/MAX4471/MAX4472)
- ♦ 40kHz Gain-Bandwidth Product (MAX4464/MAX4474)
- ♦ 250pF (min) Capacitive Load Capability
- ♦ Available in Tiny 5-Pin SC70 and 8-Pin SOT23 Packages

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE	TOP MARK
MAX4464EXK-T	-40°C to +85°C	5 SC70-5	ABT
MAX4464EUK-T	-40°C to +85°C	5 SOT23-5	ADPI
MAX4470EXK-T	-40°C to +85°C	5 SC70-5	ABS
MAX4470EUK-T	-40°C to +85°C	5 SOT23-5	ADPH
MAX4471EKA-T	-40°C to +85°C	8 SOT23-8	AAEK
MAX4471ESA	-40°C to +85°C	8 SO	—
MAX4472EUD	-40°C to +85°C	14 TSSOP	—
MAX4472ESD	-40°C to +85°C	14 SO	—
MAX4474EKA-T	-40°C to +85°C	8 SOT23-8	AAEL
MAX4474EUA	-40°C to +85°C	8 μMAX	—
MAX4474ESA	-40°C to +85°C	8 SO	—

Selector Guide

PART	NO. OF AMPLIFIERS	GAIN-BANDWIDTH	MINIMUM STABLE GAIN
MAX4464	1	40kHz	5V/V
MAX4470	1	9kHz	1V/V
MAX4471	2	9kHz	1V/V
MAX4472	4	9kHz	1V/V
MAX4474	2	40kHz	5V/V

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

ABSOLUTE MAXIMUM RATINGS

V_{DD} to V_{SS} ....-0.3V to +6V
IN_+ or IN_-......................................(V_{SS} - 0.3V) to (V_{DD} + 0.3V)
OUT_ Shorted to V_{SS} or V_{DD}......................................Continuous
Continuous Power Dissipation (T_A = +70°C)
5-Pin SC70 (derate 3.1mW/°C above +70°C)...................247mW
5-Pin SOT23 (derate 7.1mW/°C above +70°C).................571mW
8-Pin SOT23 (derate 8.9mW/°C above +70°C).................714mW
8-Pin µMAX (derate 4.5mW/°C above +70°C).................362mW
8-Pin SO (derate 5.88mW/°C above +70°C)....................471mW
14-Pin TSSOP (derate 9.1mW/°C above +70°C) 727mW
14-Pin SO (derate 8.33mW/°C above +70°C)...............667mW
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.

ELECTRICAL CHARACTERISTICS

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, V_{OUT} = V_{DD}/2, R_L = ∞ to V_{DD}/2, **T_A = +25°C**, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{DD}	Guaranteed by PSRR tests		1.8		5.5	V
Supply Current (Per Amplifier)	I_{DD}	V_{DD} = +1.8V			0.6		µA
		V_{DD} = +5.0V			0.75	1.2	
Input Offset Voltage	V_{OS}				±0.5	±7.0	mV
Input Bias Current	I_B				±200	±1500	pA
Input Offset Current	I_{OS}				±12.5		pA
Input Common-Mode Voltage Range	V_{CM}	Guaranteed by the CMRR test		V_{SS}		V_{DD} - 1.1	V
Common-Mode Rejection Ratio	CMRR	Specified with $V_{SS} \le V_{CM} \le (V_{DD} - 1.1V)$		70	95		dB
Power-Supply Rejection Ratio	PSRR	+1.8V ≤ V_{DD} ≤ +5.5V		70	90		dB
Large-Signal Voltage Gain	A_{VOL}	R_L = 1MΩ, V_{OUT} = 50mV to V_{DD} - 50mV		90	120		dB
		R_L = 100kΩ, V_{OUT} = 200mV to V_{DD} - 200mV		90	112		
		R_L = 10kΩ, V_{OUT} = 200mV to V_{DD} - 200mV			100		
Output Voltage Swing	V_{OH}	Swing high specified as V_{DD} - V_{OH}	R_L = 1MΩ		1	4	mV
			R_L = 100kΩ		4	10	
			R_L = 10kΩ		40		
	V_{OL}	Swing low specified as V_{OL} - V_{SS}	R_L = 1MΩ		0.5	5	
			R_L = 100kΩ		1	5	
			R_L = 10kΩ		10		
Gain-Bandwidth Product	GBW	MAX4470/MAX4471/MAX4472			9		kHz
		MAX4464/MAX4474			40		
Phase Margin	ϕ_M	MAX4470/MAX4471/MAX4472			90		degrees
		MAX4464/MAX4474			80		

ELECTRICAL CHARACTERISTICS (continued)

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, V_{OUT} = V_{DD}/2, R_L = ∞ to V_{DD}/2, **T_A = +25°C**, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Slew Rate	SR	V_{OUT} = 4V step	MAX4470/MAX4471/MAX4472		2		V/ms
			MAX4464/MAX4474		20		
Input Voltage Noise	e_n	f = 1kHz			150		nV/√Hz
		f = 10kHz			120		
Output Short-Circuit Current		Shorted to V_{SS} (sourcing)			11		mA
		Shorted to V_{DD} (sinking)			36		
Power-On Time	t_{ON}				2		µs
Power-Off Time	t_{OFF}				2		µs
Capacitive Load	C_{LOAD}	No sustained oscillations		250			pF

ELECTRICAL CHARACTERISTICS

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, V_{OUT} = V_{DD}/2, R_L = ∞ to V_{DD}/2, **T_A = T_{MIN} to T_{MAX}**, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{DD}	Guaranteed by PSRR tests		1.8		5.5	V
Supply Current (Per Amplifier)	I_{DD}	V_{DD} = +5.0V				1.5	µA
Input Offset Voltage	V_{OS}					±15	mV
Input Offset Voltage Temperature Coefficient	TCV_{OS}				8		µV/°C
Input Bias Current	I_B					4.25	nA
Input Common-Mode Voltage Range	V_{CM}	Guaranteed by the CMRR test		V_{SS}		V_{DD} - 1.1	V
Common-Mode Rejection Ratio	CMRR	$V_{SS} \le V_{CM} \le (V_{DD} - 1.1V)$		56			dB
Power-Supply Rejection Ratio	PSRR	$+1.8V \le V_{DD} \le +5.5V$, $0°C \le T_A \le +85°C$		65			dB
		$+2V \le V_{DD} \le +5.5V$, $-40°C \le T_A \le +85°C$		65			
Large-Signal Voltage Gain	A_{VOL}	V_{OUT} = 50mV to V_{DD} - 50mV, R_L = 1MΩ		75			dB
		V_{OUT} = 200mV to V_{DD} - 200mV, R_L = 100kΩ		75			
Output Voltage Swing	V_{OH}	Swing high specified as V_{DD} - V_{OH}	R_L = 1MΩ			5	mV
			R_L = 100kΩ			15	
	V_{OL}	Swing low specified as V_{OL} - V_{SS}	R_L = 1MΩ			5	
			R_L = 100kΩ			5	

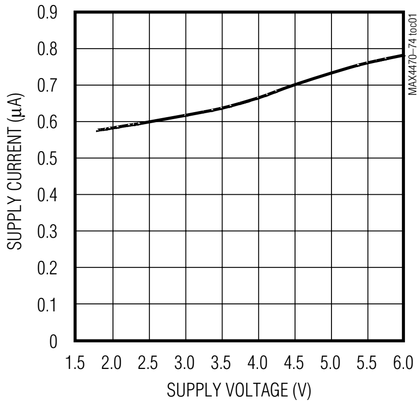
Note 1: All devices are production tested at T_A = +25°C. All temperature limits are guaranteed by design.

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

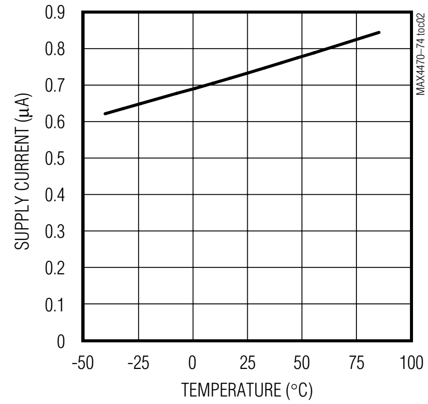
Typical Operating Characteristics

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

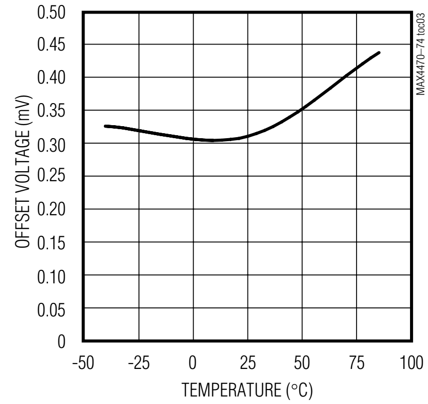
SUPPLY CURRENT PER AMPLIFIER vs. SUPPLY VOLTAGE



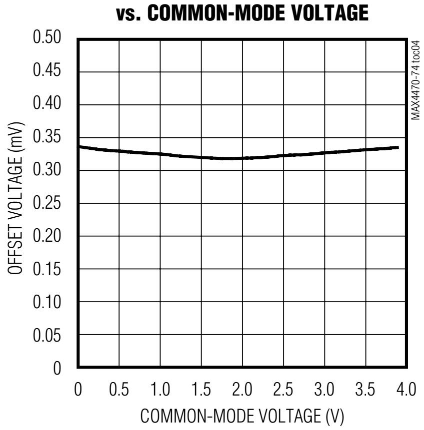
SUPPLY CURRENT PER AMPLIFIER vs. TEMPERATURE



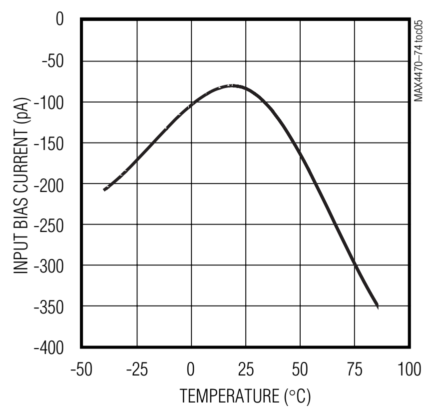
OFFSET VOLTAGE vs. TEMPERATURE



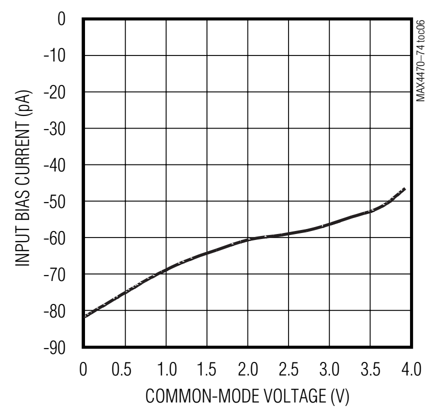
OFFSET VOLTAGE vs. COMMON-MODE VOLTAGE



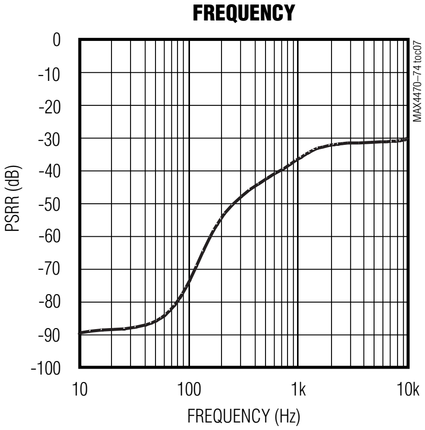
INPUT BIAS CURRENT vs. TEMPERATURE



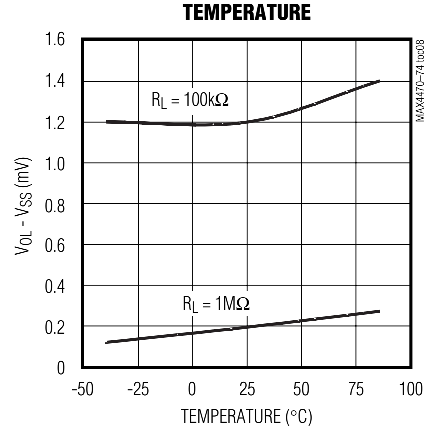
INPUT BIAS CURRENT vs. COMMON-MODE VOLTAGE



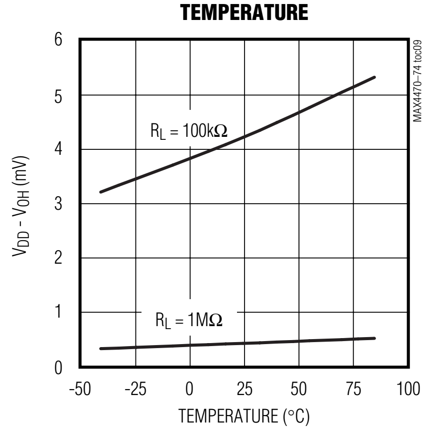
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



OUTPUT VOLTAGE SWING LOW vs. TEMPERATURE



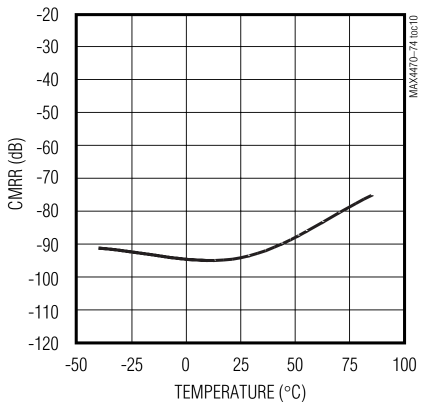
OUTPUT VOLTAGE SWING HIGH vs. TEMPERATURE



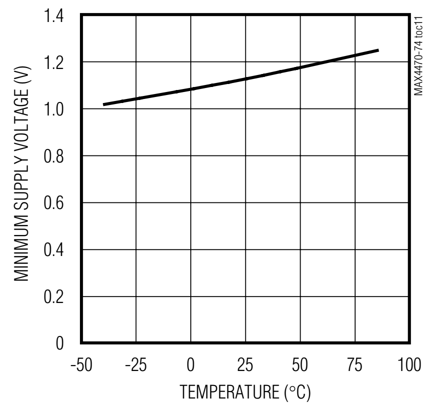
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

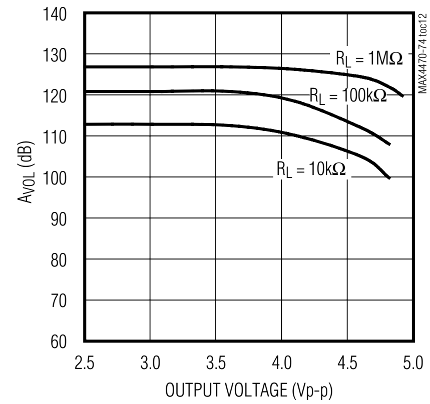
COMMON-MODE REJECTION RATIO vs. TEMPERATURE



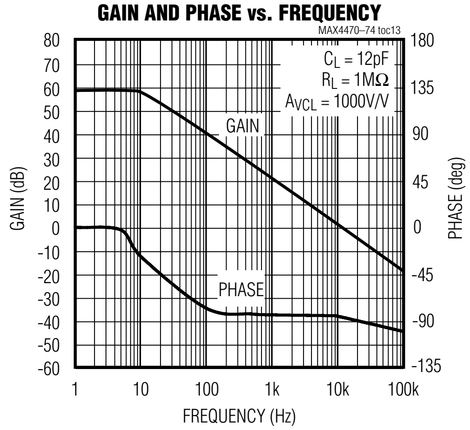
MINIMUM SUPPLY VOLTAGE vs. TEMPERATURE



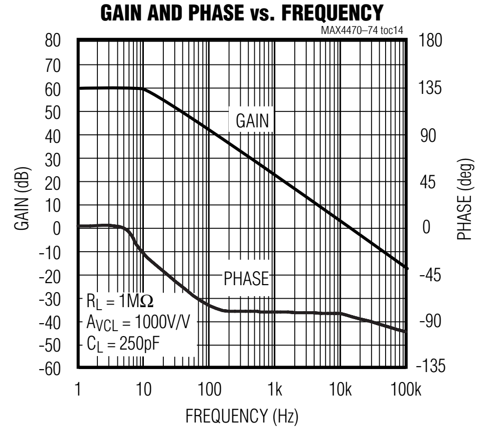
A_{VOL} vs. OUTPUT VOLTAGE SWING



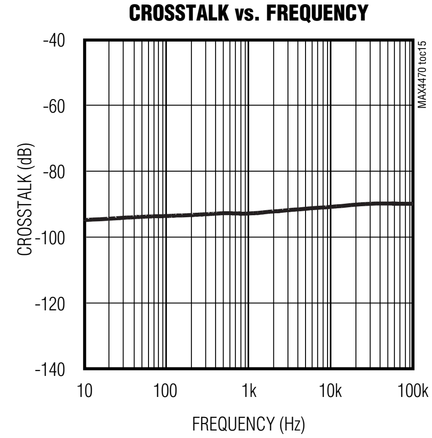
MAX4470/MAX4471/MAX4472 GAIN AND PHASE vs. FREQUENCY



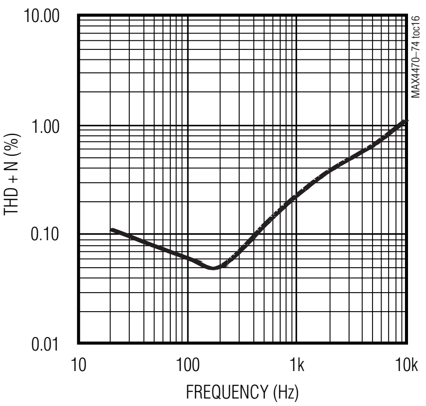
MAX4470/MAX4471/MAX4472 GAIN AND PHASE vs. FREQUENCY



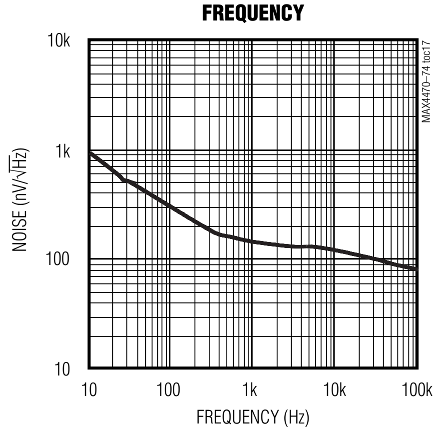
CROSSTALK vs. FREQUENCY



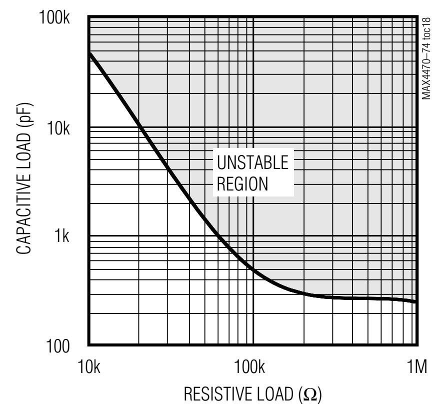
MAX4470/MAX4471/MAX4472 TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



VOLTAGE NOISE DENSITY vs. FREQUENCY



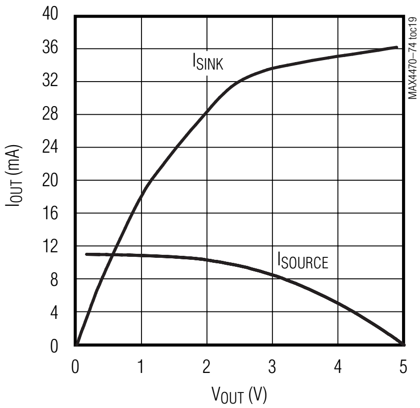
MAX4470/MAX4471/MAX4472 STABILITY vs. CAPACITIVE AND RESISTIVE LOADS



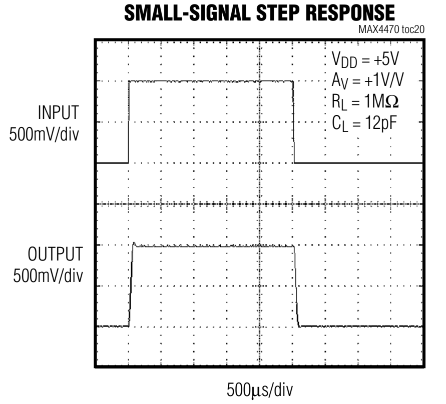
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

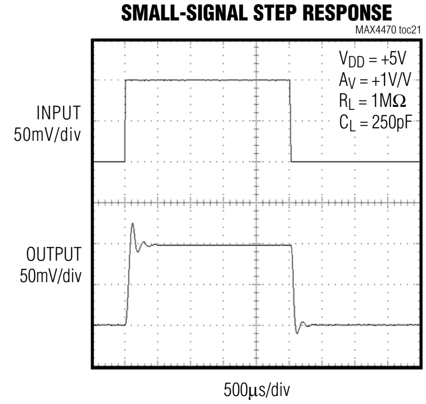
I_{OUT} vs. V_{OUT}



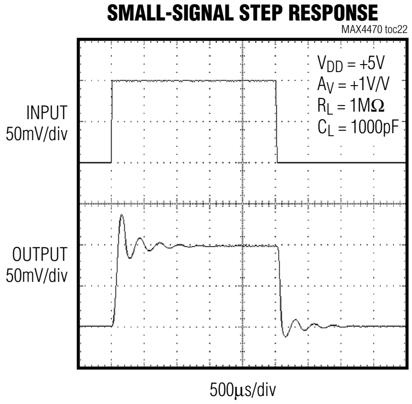
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL STEP RESPONSE



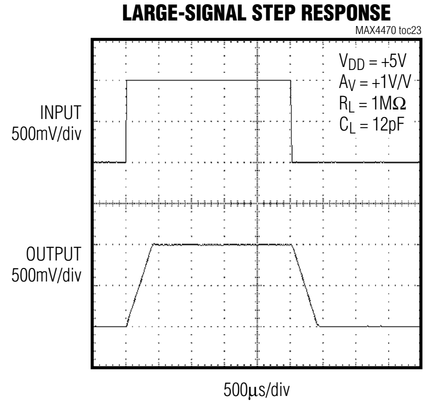
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL STEP RESPONSE



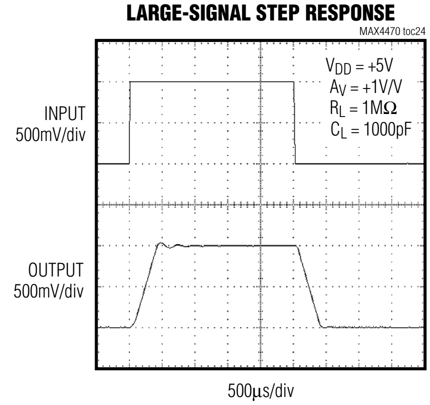
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL STEP RESPONSE



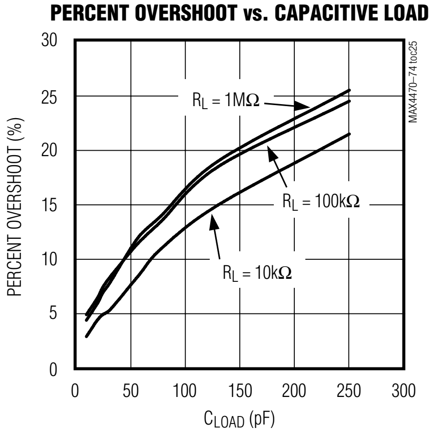
MAX4470/MAX4471/MAX4472 LARGE-SIGNAL STEP RESPONSE



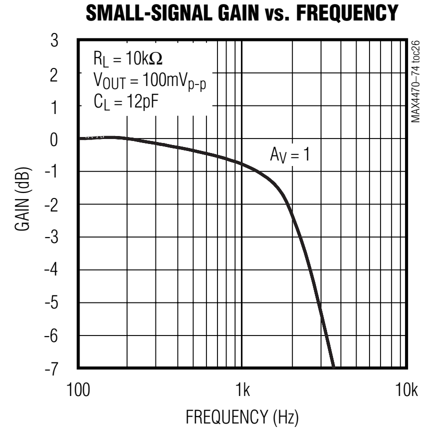
MAX4470/MAX4471/MAX4472 LARGE-SIGNAL STEP RESPONSE



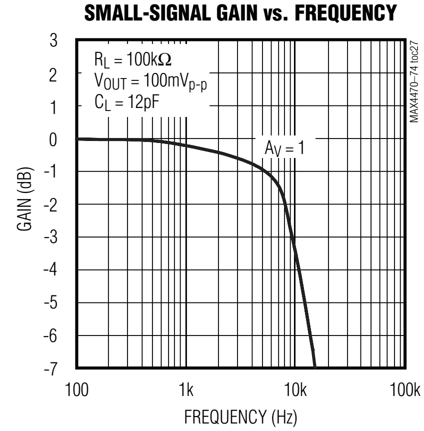
MAX4470/MAX4471/MAX4472 PERCENT OVERSHOOT vs. CAPACITIVE LOAD



MAX4470/MAX4471/MAX4472 SMALL-SIGNAL GAIN vs. FREQUENCY



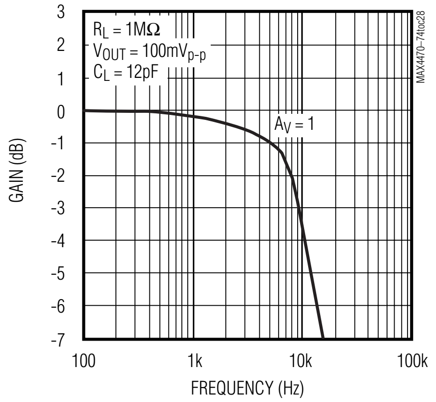
MAX4470/MAX4471/MAX4472 SMALL-SIGNAL GAIN vs. FREQUENCY



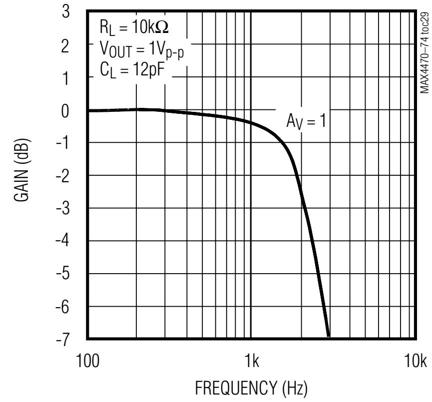
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

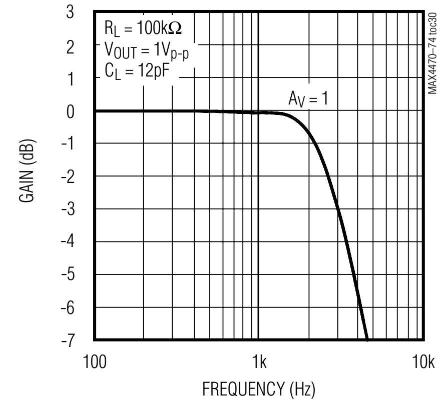
MAX4470/MAX4471/MAX4472
SMALL-SIGNAL GAIN vs. FREQUENCY



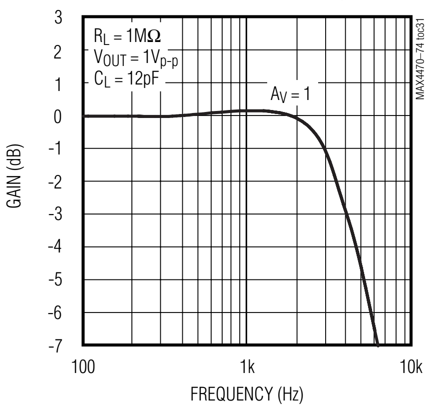
MAX4470/MAX4471/MAX4472
LARGE-SIGNAL GAIN vs. FREQUENCY



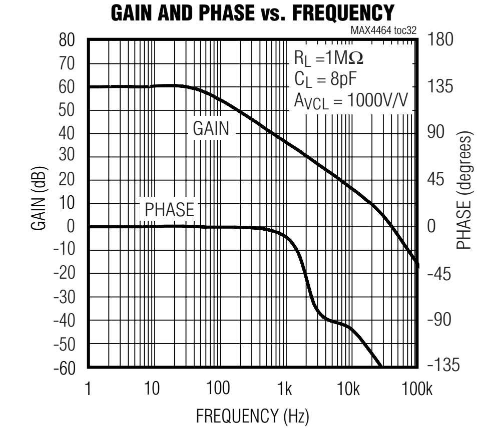
MAX4470/MAX4471/MAX4472
LARGE-SIGNAL GAIN vs. FREQUENCY



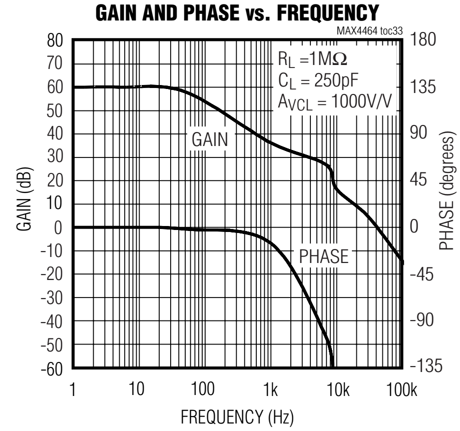
MAX4470/MAX4471/MAX4472
LARGE-SIGNAL GAIN vs. FREQUENCY



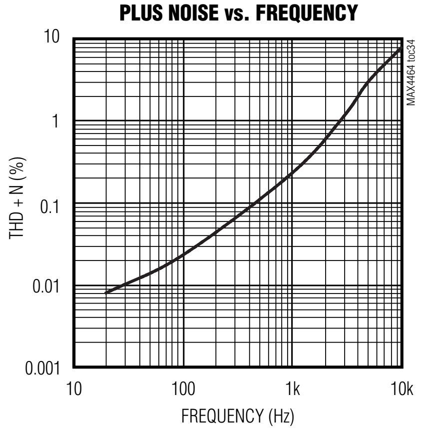
MAX4464/MAX4474
GAIN AND PHASE vs. FREQUENCY



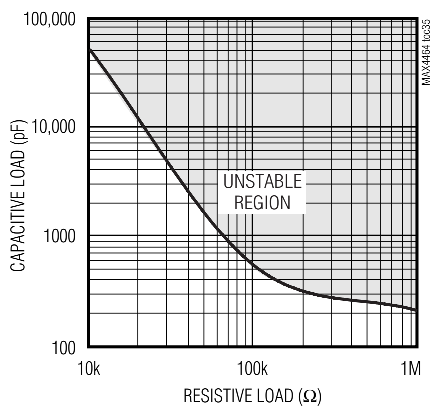
MAX4464/MAX4474
GAIN AND PHASE vs. FREQUENCY



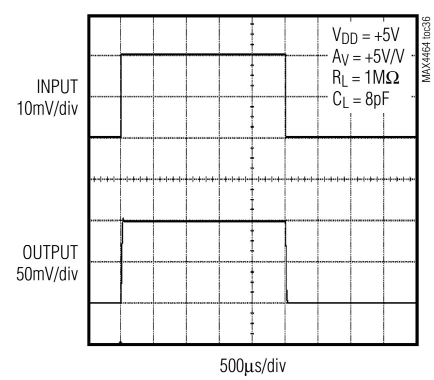
MAX4464/MAX4474
TOTAL HARMONIC DISTORTION PLUS NOISE vs. FREQUENCY



MAX4464/MAX4474
STABILITY vs. CAPACITIVE AND RESISTIVE LOADS



MAX4464/MAX4474
SMALL-SIGNAL STEP RESPONSE

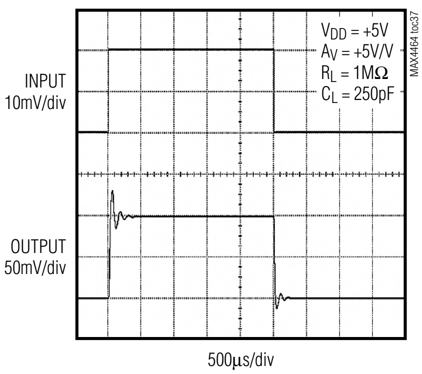


Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

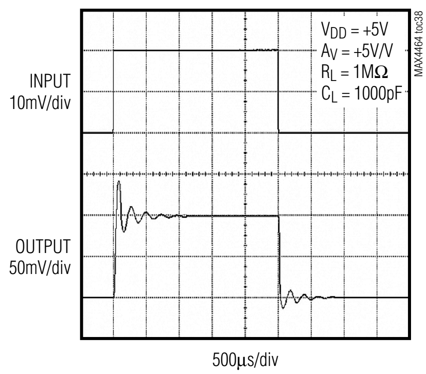
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)

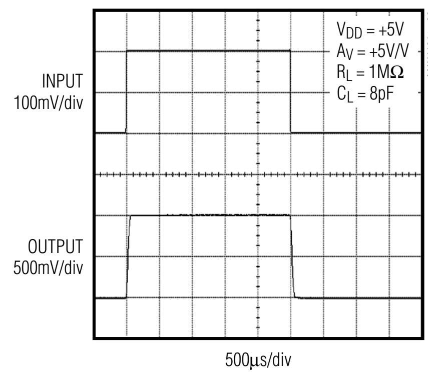
MAX4464/MAX4474
SMALL-SIGNAL STEP RESPONSE



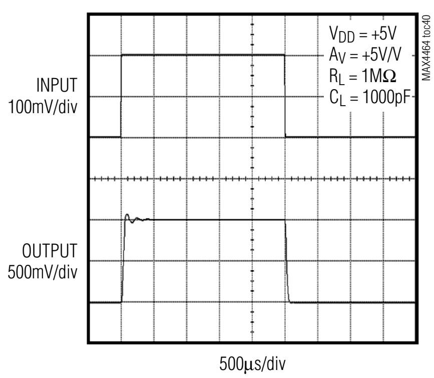
MAX4464/MAX4474
SMALL-SIGNAL STEP RESPONSE



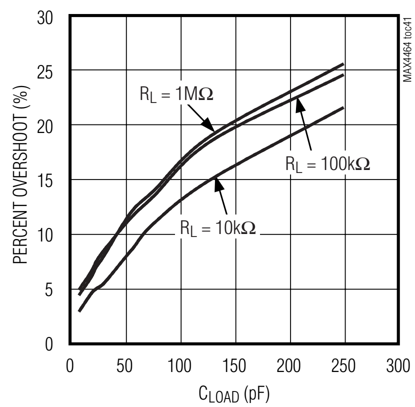
MAX4464/MAX4474
LARGE-SIGNAL STEP RESPONSE



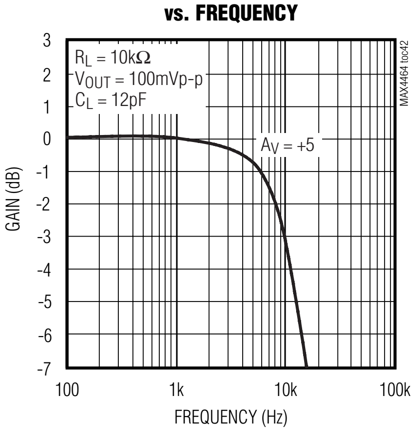
MAX4464/MAX4474
LARGE-SIGNAL STEP RESPONSE



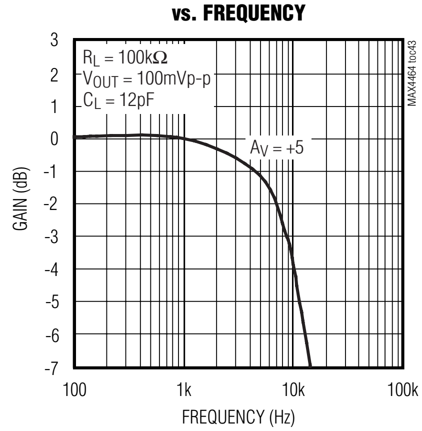
MAX4464/MAX4474
PERCENT OVERSHOOT vs. CAPACITIVE LOAD



MAX4464/MAX4474
SMALL-SIGNAL NORMALIZED GAIN vs. FREQUENCY



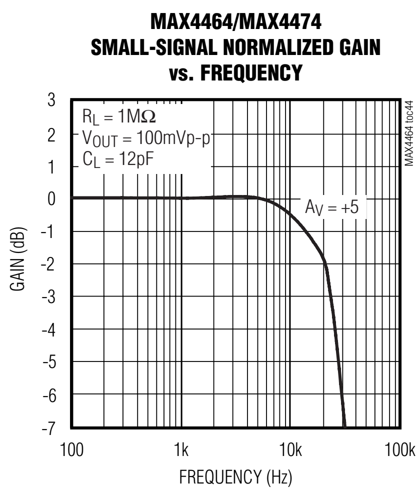
MAX4464/MAX4474
SMALL-SIGNAL NORMALIZED GAIN vs. FREQUENCY

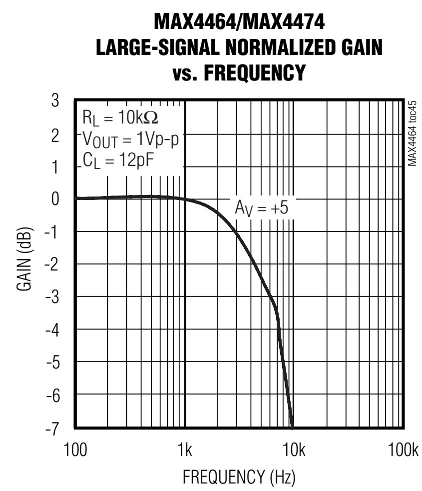


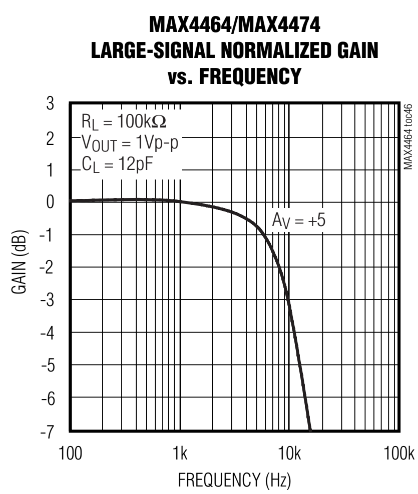
Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

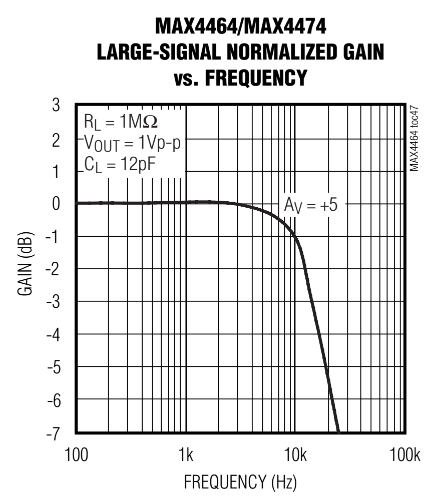
Typical Operating Characteristics (continued)

(V_{DD} = +5V, V_{SS} = 0, V_{CM} = 0, R_L = 100kΩ to V_{DD}/2, T_A = +25°C, unless otherwise noted.)









Pin Description

PIN			NAME	FUNCTION
MAX4470/ MAX4464	MAX4471/ MAX4474	MAX4472		
1	—	—	IN+	Noninverting Amplifier Input
—	3	3	INA+	Noninverting Amplifier Input (Channel A)
2	4	11	V_{SS}	Negative Power-Supply Voltage
3	—	—	IN-	Inverting Amplifier Input
4	—	—	OUT	Amplifier Output
—	2	2	INA-	Inverting Amplifier Input (Channel A)

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

Pin Description (continued)

PIN			NAME	FUNCTION
MAX4470/ MAX4464	MAX4471/ MAX4474	MAX4472		
—	1	1	OUTA	Amplifier Output (Channel A)
—	6	6	INB-	Inverting Amplifier Input (Channel B)
—	5	5	INB+	Noninverting Amplifier Input (Channel B)
—	7	7	OUTB	Amplifier Output (Channel B)
—	—	9	INC-	Inverting Amplifier Input (Channel C)
—	—	10	INC+	Noninverting Amplifier Input (Channel C)
—	—	8	OUTC	Amplifier Output (Channel C)
—	—	13	IND-	Inverting Amplifier Input (Channel D)
—	—	12	IND+	Noninverting Amplifier Input (Channel D)
—	—	14	OUTD	Amplifier Output (Channel D)
5	8	4	V_{DD}	Positive Power-Supply Voltage

Applications Information

Ground Sensing

The common-mode input range of the MAX4470 family extends down to ground, and offers excellent common-mode rejection. These devices are guaranteed not to undergo phase reversal when the input is overdriven.

Power Supplies and Layout

The MAX4470 family operates from a single +1.8V to +5.5V power supply. Bypass power supplies with a 0.1µF ceramic capacitor placed close to the V_{DD} pin.

Ground layout improves performance by decreasing the amount of stray capacitance and noise at the op amp's inputs and outputs. To decrease stray capacitance, minimize PC board lengths and resistor leads, and place external components close to the op amps' pins.

Bandwidth

The MAX4470/MAX4471/MAX4472 are internally compensated for unity-gain stability and have a typical gain-bandwidth of 9kHz. The MAX4464/MAX4474 have a 40kHz typical gain-bandwidth and are stable for a gain of +5V/V or greater.

Stability

The MAX4464/MAX4470/MAX4471/MAX4472/MAX4474 maintain stability in their minimum gain configuration while driving capacitive loads. Although this product family is primarily designed for low-frequency applications, good layout is extremely important because low-power requirements demand high-impedance circuits. The layout should also minimize stray capacitance at the amplifier inputs. However some stray capacitance may be unavoidable, and it may be necessary to add a 2pF to 10pF capacitor across the feedback resistor as shown in Figure 2. Select the smallest capacitor value that ensures stability.

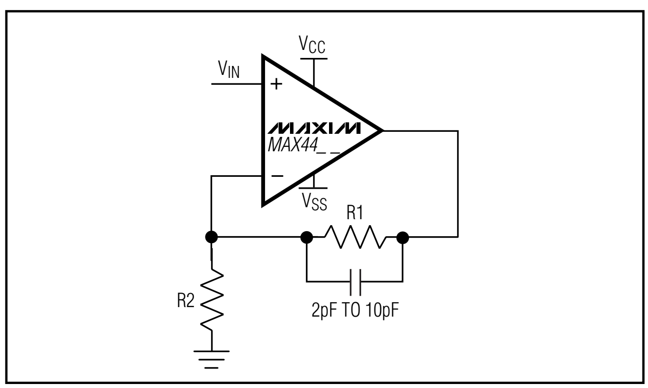
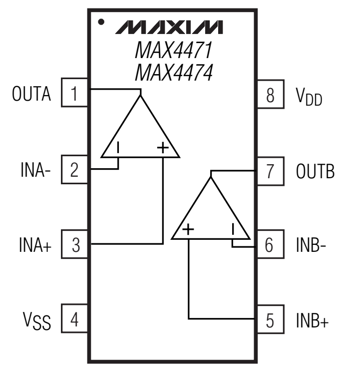


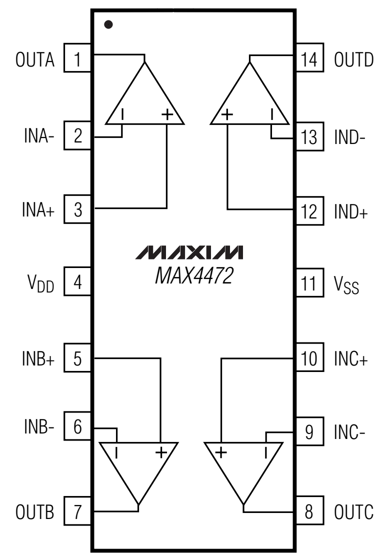
Figure 2. Compensation for Feedback Node Capacitance

Pin Configurations (continued)

TOP VIEW



SOT23/μMAX/SO



SO/TSSOP

Chip Information

MAX4470/MAX4464 TRANSISTOR COUNT: 147

MAX4471/MAX4474 TRANSISTOR COUNT: 293

MAX4472 TRANSISTOR COUNT: 585

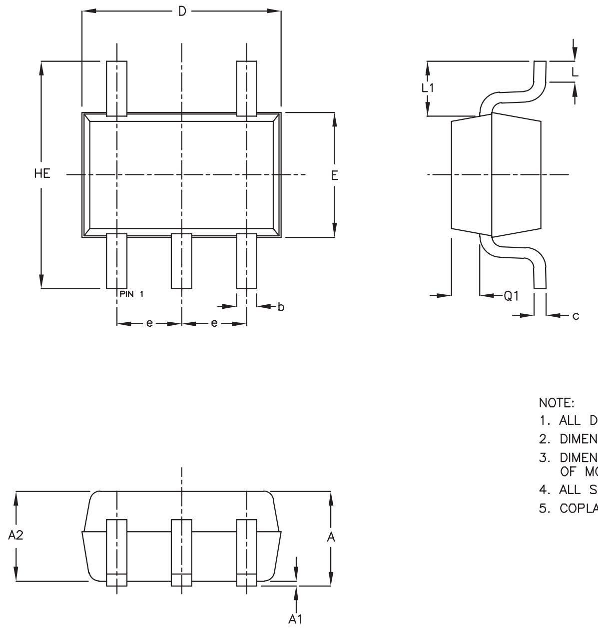
PROCESS: BiCMOS

Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

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**.)

SC70, 5L.EPS

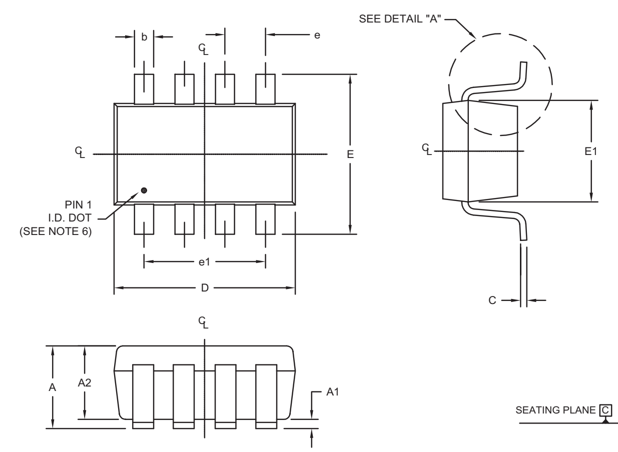


SYMBOL	MIN	MAX
e	0.65 BSC	
D	1.80	2.20
b	0.15	0.30
E	1.15	1.35
HE	1.80	2.40
Q1	0.10	0.40
A2	0.80	1.00
A1	0.00	0.10
A	0.80	1.10
c	0.10	0.18
L	0.10	0.30
L1	0.425 TYP.	

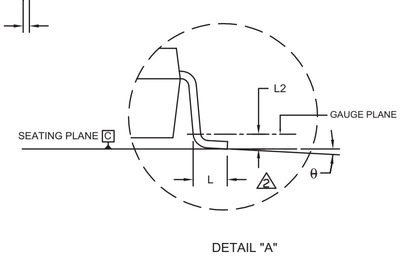
NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. DIMENSIONS ARE INCLUSIVE OF PLATING
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR
4. ALL SPECIFICATIONS COMPLY TO EIAJ SC70
5. COPLANARITY 4 MILS. MAX.

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, SC70, 5L
APPROVAL | DOCUMENT CONTROL NO. 21-0076 | REV B | 1/1

SOT23, 8L .EPS



SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.28	0.45
C	0.09	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.30	0.60
L2	0.25 BSC.	
e	0.65 BSC.	
e1	1.95 REF.	
θ	0∞	8∞



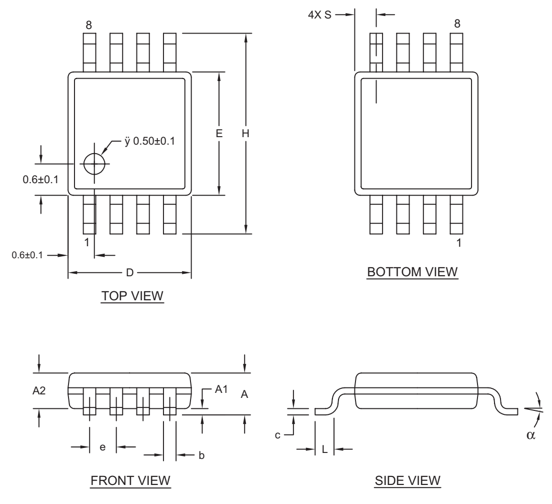
DETAIL "A"

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED FROM LEAD TIP TO UPPER RADIUS OF HEEL OF THE LEAD PARALLEL TO SEATING PLANE C.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. COPLANARITY 4 MILS. MAX.
6. PIN 1 I.D. DOT IS 0.3 MM ÿ MIN. LOCATED ABOVE PIN 1.
7. SOLDER THICKNESS MEASURED AT FLAT SECTION OF LEAD BETWEEN 0.08mm AND 0.15mm FROM LEAD TIP.
8. MEETS JEDEC MO178.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, SOT-23, 8L BODY
APPROVAL | DOCUMENT CONTROL NO. 21-0078 | REV. D | 1/1

Package Information (continued)

(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**.)

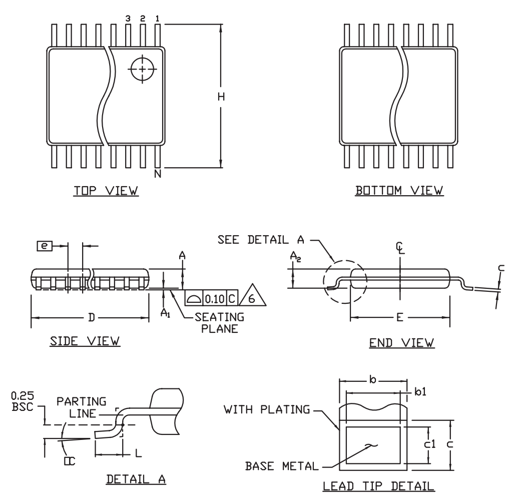


DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	-	0.043	-	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
b	0.010	0.014	0.25	0.36
c	0.005	0.007	0.13	0.18
D	0.116	0.120	2.95	3.05
e	0.0256 BSC		0.65 BSC	
E	0.116	0.120	2.95	3.05
H	0.188	0.198	4.78	5.03
L	0.016	0.026	0.41	0.66
α	0∞	6∞	0∞	6∞
S	0.0207 BSC		0.5250 BSC	

8LUMAXD.EPS

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187C-AA.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 8L uMAX/uSOP
APPROVAL | DOCUMENT CONTROL NO. 21-0036 | REV. J | 1/1



SYMBOL	COMMON DIMENSIONS MILLIMETERS MIN.	MILLIMETERS MAX.	INCHES MIN.	INCHES MAX.
A	——	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b_1	0.19	0.25	.007	.010
c	0.09	0.20	.004	.008
c_1	0.09	0.14	.004	.006
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.55	.246	.258
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°

JEDEC MO-153	N		VARIATIONS MILLIMETERS MIN.	MILLIMETERS MAX.	INCHES MIN.	INCHES MAX.
AB-1	14	D	4.90	5.10	.193	.201
AB	16	D	4.90	5.10	.193	.201
AC	20	D	6.40	6.60	.252	.260
AD	24	D	7.70	7.90	.303	.311
AE	28	D	9.60	9.80	.378	.386

TSSOP4.40mm.EPS

NOTES:
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. THE LEAD TIPS MUST LIE WITHIN A SPECIFIED ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL PLANES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-]; THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, TSSOP 4.40mm BODY
APPROVAL | DOCUMENT CONTROL NO. 21-0066 | REV. F | 1/1

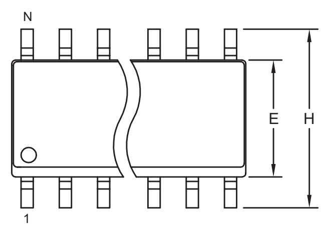
Single/Dual/Quad, +1.8V/750nA, SC70, Rail-to-Rail Op Amps

Package Information (continued)

(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**.)

SOICN .EPS

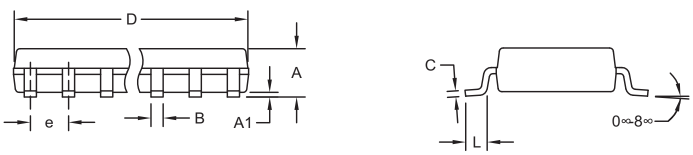
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27



TOP VIEW

VARIATIONS:

	INCHES		MILLIMETERS			
DIM	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	AA
D	0.337	0.344	8.55	8.75	14	AB
D	0.386	0.394	9.80	10.00	16	AC



FRONT VIEW

SIDE VIEW

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
4. CONTROLLING DIMENSION: MILLIMETERS.
5. MEETS JEDEC MS012.
6. N = NUMBER OF PINS.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, .150" SOIC

APPROVAL | DOCUMENT CONTROL NO. 21-0041 | REV. B | 1/1

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