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19-2772; Rev 4; 4/07

High-Precision, Low-Voltage, Micropower Op Amp

MAX480

General Description

The MAX480 is a precision micropower operational amplifier with flexible power-supply capability. Its guaranteed 140µV maximum offset voltage (25µV typ) is the lowest of any micropower op amp. Similarly, input bias current, input offset current, and drift specifications are within tight limits.

Both the input and output voltage ranges include the negative supply rail, allowing maximum signal range capability in single-supply applications. The MAX480 operates with either a single supply ranging from +1.6V to +36V or dual supplies from ±0.8V to ±18V. The MAX480 consumes less than 20µA, allowing operation in excess of 10,000 hours from a 250mA-hr lithium coin cell. Even with a minimal quiescent current, the amplifier sinks or sources 5mA from its output.

The MAX480 is available in 8-pin DIP and SO packages in commercial, extended, and military temperature ranges.

Applications

Precision Micropower Amplifiers

Micropower Signal Processing

Battery-Powered Analog Circuits

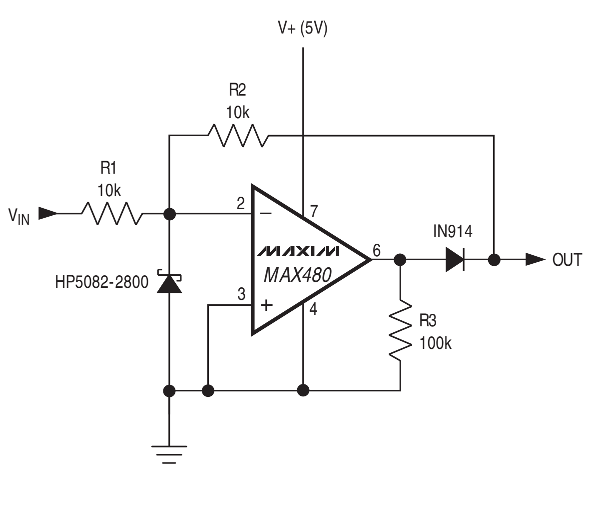
Features

- ♦ **Single- or Dual-Supply Operation: +1.6V to +36V, ±0.8V to ±18V**
- ♦ **True Single-Supply Operation: Input and Output Voltage Ranges Include Ground**
- ♦ **2.0µV/°C Max Offset Voltage Drift**
- ♦ **20µA Max Supply Current**
- ♦ **5mA Min Output Drive**
- ♦ **140µV Max Input Offset Voltage**
- ♦ **3nA Max Input Bias Current**
- ♦ **500V/mV Min Open-Loop Gain**
- ♦ **Standard 741 Pinout with Nulling to V-**

Ordering Information

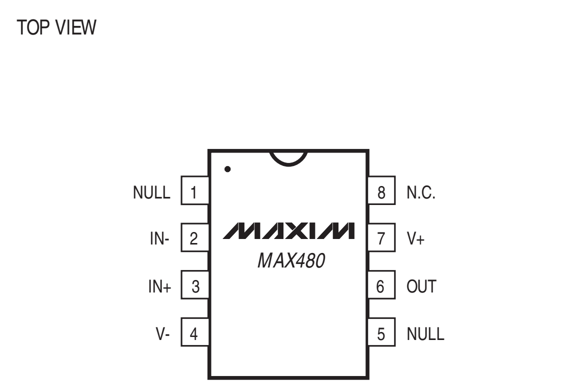
PART	TEMP RANGE	PIN-PACKAGE
MAX480CPA	0°C to +70°C	8 Plastic DIP
MAX480CSA	0°C to +70°C	8 SO
MAX480EPA	-40°C to +85°C	8 Plastic DIP
MAX480ESA	-40°C to +85°C	8 SO
MAX480MJA	-55°C to +125°C	8 CERDIP

Typical Operating Circuit



SINGLE OP AMP FULL-WAVE RECTIFIER

Pin Configuration



DIP/SO

High-Precision, Low-Voltage, Micropower Op Amp

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V+ to V-) ....±18V
Differential Input Voltage ....(V- - 20V) to (V+ + 20V)
Common-Mode Input Voltage ....(V- - 20V) to (V+ + 20V)
Output Short-Circuit Duration ....Indefinite
Continuous Power Dissipation
Plastic DIP (derate 9.09mW/°C above +70°C) 727mW
SO (derate 5.88mW/°C above +70°C).............................471mW
CERDIP (derate 8.0mW/°C above +70°C)...................640mW

Operating Temperature Ranges
MAX480C_A...0°C to +70°C
MAX480E_A..-40°C to +85°C
MAX480MJA ....-55°C to +125°C
Junction Temperature (T_J)..................................-65°C to +150°C
Storage Temperature Range ....-65°C to +150°C
Lead Temperature (soldering, 10sec) ....+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_S = ±1.5V to ±15V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Offset Voltage	V_{OS}				25	140	µV
Input Offset Current	I_{OS}	V_{CM} = 0			0.2	4	nA
Input Bias Current	I_B	V_{CM} = 0			1	10	nA
Large-Signal Voltage Gain	A_{VO}	V_S = ±15V, V_O = ±10V	R_L = 100kΩ	500	1200		V/mV
			R_L = 10kΩ	200	600		
			R_L = 2kΩ	75	250		
		V+ = 5V, V- = 0, 1V < V_O < 4V	R_L = 100kΩ	100	400		
			R_L = 10kΩ	50	180		
Input Voltage	IVR	V+ = 5V, V- = 0		0/4			V
		V_S = ±15V (Note 1)		-15/13.5			
Output Voltage Swing	V_O	V_S = ±15V	R_L = 10kΩ	±14	±14.2		V
			R_L = 2kΩ	±10	±12		
	V_{OH}	V+ = 5V, V- = 0, R_L = 2kΩ		4.0	4.2		
	V_{OL}	V+ = 5V, V- = 0, R_L = 10kΩ			100	500	µV
Common-Mode Rejection Ratio	CMRR	V+ = 5V, V- = 0, 0 < V_{CM} < 4V		85	110		dB
		V_S = ±15V, -15V < V_{CM} < 13.5V		90	130		
Power-Supply Rejection Ratio	PSRR				1.0	12	µV/V
Slew Rate	SR	V_S = ±15V			12		V/ms
Supply Current	I_{SY}	V_S = ±1.5V			9	15	µA
		V_S = ±15V			14	20	
Capacitive Load Stability		A_V = +1V/V, no oscillations (Note 2)			650		pF
Input Noise Voltage	e_{np-p}	f_O = 0.1Hz to 10Hz, V_S = ±15V			3		µVp-p
Differential-Mode Input Resistance	R_{IN}	V_S = ±15V			30		MΩ
Common-Mode Input Resistance	R_{INCM}	V_S = ±15V			20		GΩ

ELECTRICAL CHARACTERISTICS

(V_S = ±1.5V to ±15V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MAX480C MIN	MAX480C TYP	MAX480C MAX	MAX480E MIN	MAX480E TYP	MAX480E MAX	MAX480M MIN	MAX480M TYP	MAX480M MAX	UNITS
Input Offset Voltage	V_{OS}				40	220		50	250		70	300	µV
Input Offset Voltage Drift	TCV_{OS}	(Note 2)			0.3	2.0		0.3	2.0		0.3	2.0	µV/°C
Input Offset Current	I_{OS}	V_{CM} = 0			0.2	5.0		0.3	7.0		0.5	10.0	nA
Input Bias Current	I_B	V_{CM} = 0			1	15		2	20		3	30	nA
Large-Signal Voltage Gain	A_{VO}	V_S = ±15V, V = ±10V	R_L = 100kΩ	350	950		350	800		60	400		V/mV
			R_L = 10kΩ	130	400		130	400		45	240		
			R_L = 2kΩ	55	125		55	150		30	110		
		V+ = 5V, V- = 0, 1V < V_O < 4V	R_L = 100kΩ	50	360		50	280		35	200		
			R_L = 10kΩ	30	150		30	140		22	110		
Input Voltage Range	IVR	V+ = 5V, V- = 0		0/3.5			0/3.5			0/3.5			V
		V_S = ±15V (Note 1)		-15/13.5			-15/13.5			-15/13.5			
Output Voltage Swing	V_O	V_S = ±15V	R_L = 10kΩ	±13.5	±14		±13.5	±14		±13.5	±13.7		V
			R_L = 2kΩ	±9.5	±11.8		±9.5	±11.8		±10.5	±11.5		
	V_{OH}	V+ = 5V, V- = 0, R_L = 2kΩ		3.9	4.1		3.9	4.1		3.9	4.1		
	V_{OL}	V+ = 5V, V- = 0, R_L = 10kΩ			100	500		100	500		100	500	µV
Common-Mode Rejection Ratio	CMRR	V+ = 5V, V- = 0, 0 < V_{CM} < 3.5V		85	110		85	110		80	105		dB
		V_S = ±15V, -15V < V_{CM} < 13.5V		90	120		90	120		85	115		
Power-Supply Rejection Ratio	PSRR				1.0	12		1.0	12		3.2	15	µV/V
Supply Current	I_{SY}	V_S = ±1.5V			12	25		13	25		15	25	µA
		V_S = ±15V			16	30		17	30		19	30	

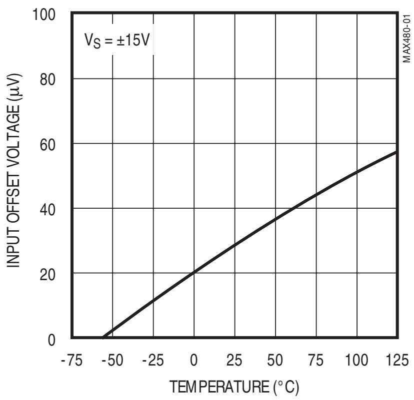
Note 1: Guaranteed by CMRR test.
Note 2: Guaranteed by design.

High-Precision, Low-Voltage, Micropower Op Amp

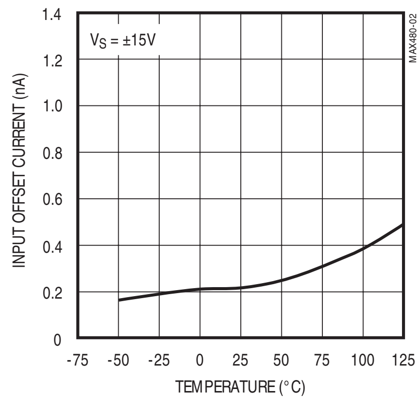
Typical Operating Characteristics

(T_A = +25°C, unless otherwise noted.)

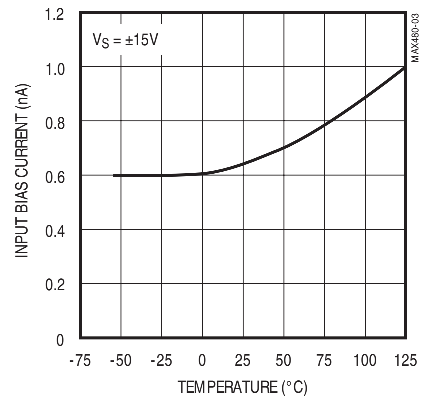
INPUT OFFSET VOLTAGE vs. TEMPERATURE



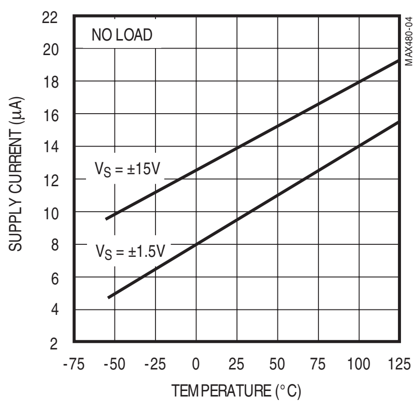
INPUT OFFSET CURRENT vs. TEMPERATURE



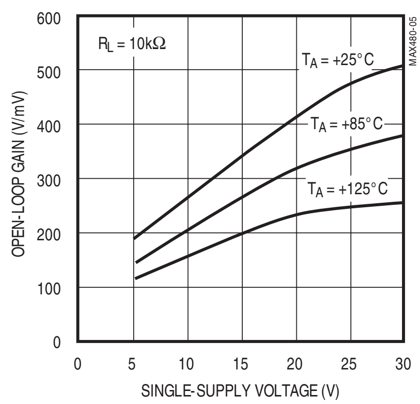
INPUT BIAS CURRENT vs. TEMPERATURE



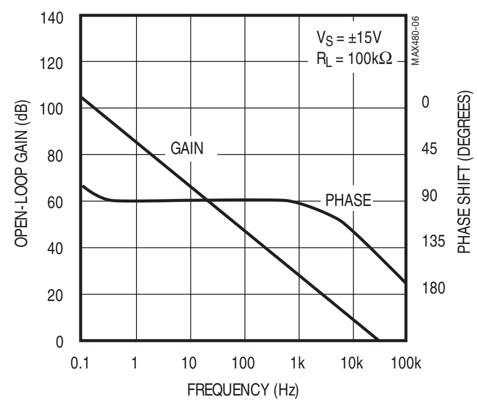
SUPPLY CURRENT vs. TEMPERATURE



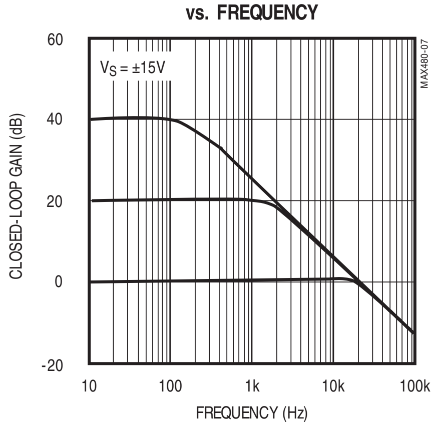
OPEN-LOOP GAIN vs. SINGLE-SUPPLY VOLTAGE



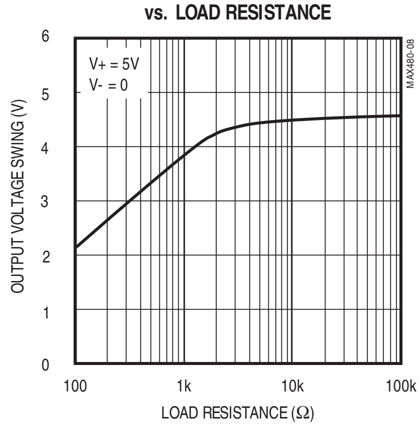
OPEN-LOOP GAIN AND PHASE SHIFT vs. FREQUENCY



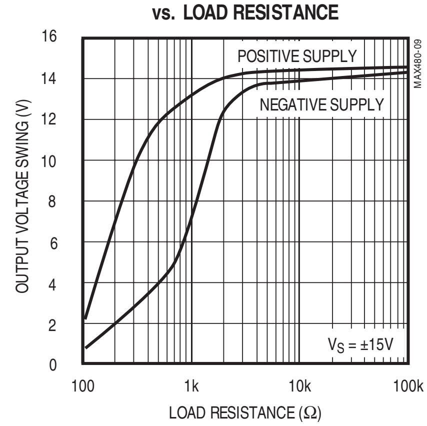
CLOSED-LOOP GAIN vs. FREQUENCY



OUTPUT VOLTAGE SWING vs. LOAD RESISTANCE

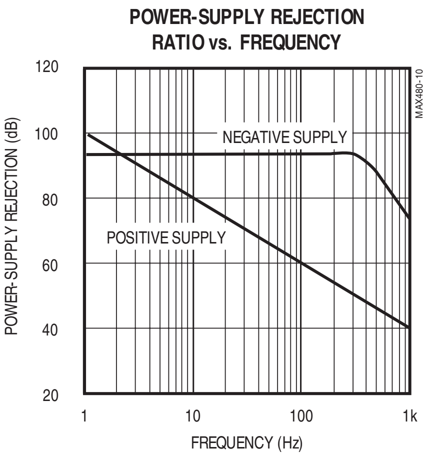


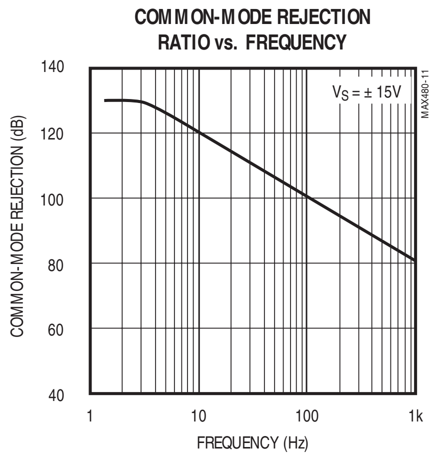
OUTPUT VOLTAGE SWING vs. LOAD RESISTANCE

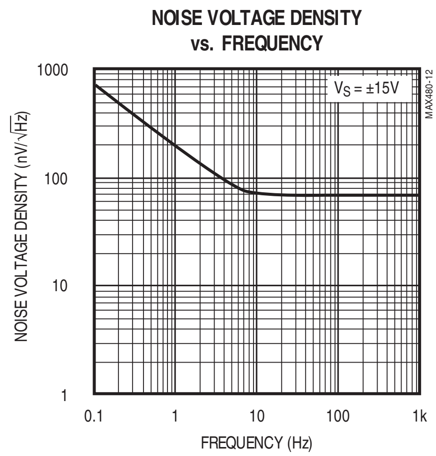


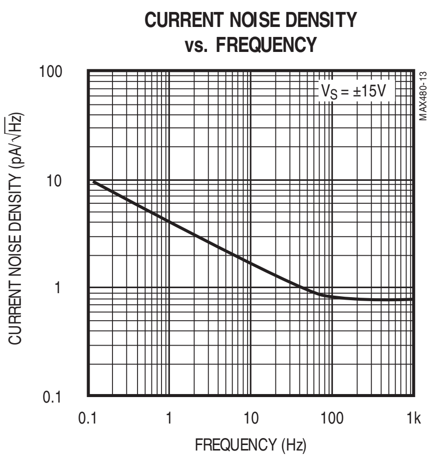
Typical Operating Characteristics (continued)

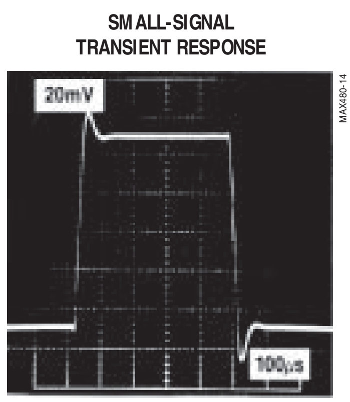
(T_A = +25°C, unless otherwise noted.)





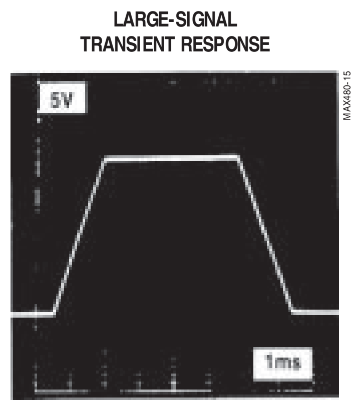






100μs/div

V_S = ±15V, A_V = +1,
R_L = 10kΩ, C_L = 500pF



1ms/div

V_S = ±15V, A_V = +1,
R_L = 10kΩ, C_L = 500pF

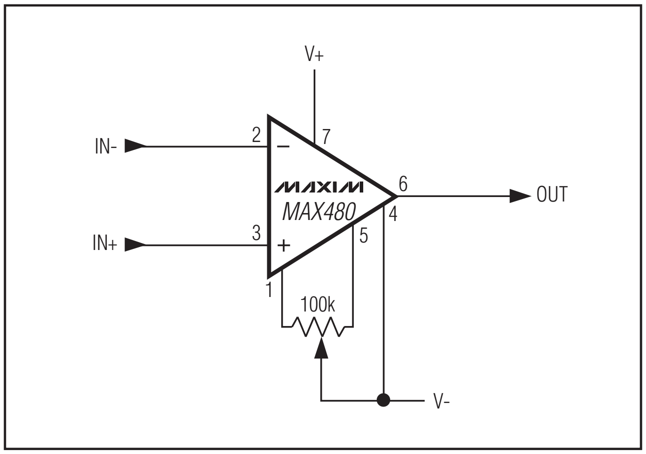


Figure 1. Offset Nulling Circuit

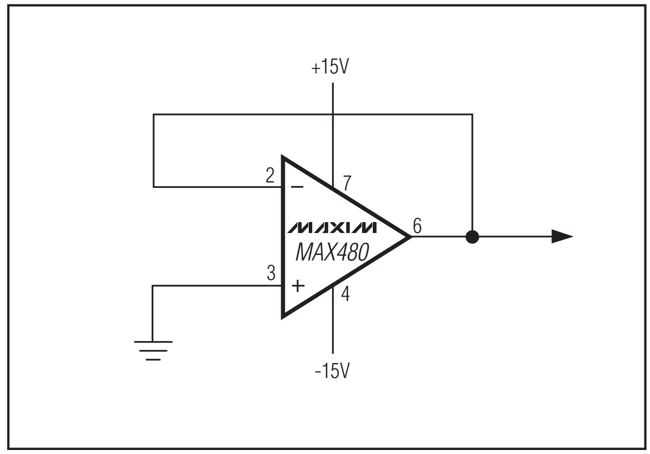


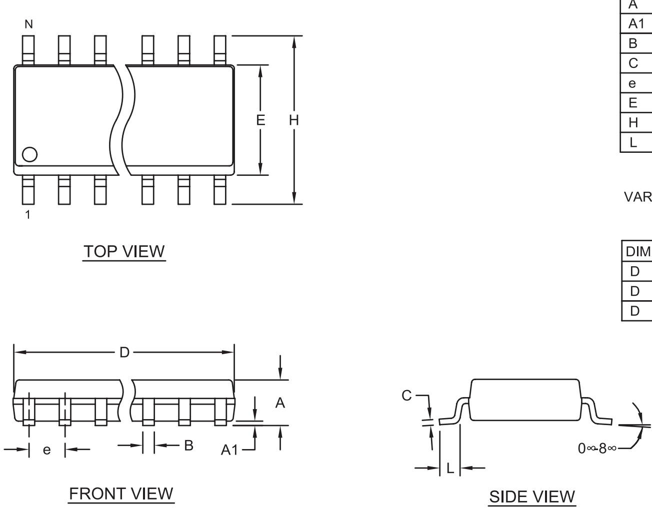
Figure 2. Burn-In Circuit

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**.)

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



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

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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