

# Dual/Quad Low Noise, Precision Operational Amplifiers

## FEATURES

- Low Noise 5nV/√Hz @ 1kHz Max
- Input Offset Voltage OP-270: 75μV Max  
OP-470: 400μV Max
- Low Offset Voltage Drift OP-270: 1μV/°C Max  
OP-470: 2μV/°C Max
- Very High Gain OP-270: 1500V/mV Min  
OP-470: 1000V/mV Min
- Outstanding CMRR OP-270: 106dB Min  
OP-470: 110dB Min
- Slew Rate 3.0V/μs Typ
- Gain Bandwidth Product 6MHz Typ
- Industry Standard Pinouts

## APPLICATIONS

- Two and Three Op Amp Instrumentation Amplifiers
- Low Noise Signal Processing
- Microvolt Accuracy Threshold Detection
- Strain Gauge Amplifiers
- Accelerometer Amplifiers
- Infrared Detectors

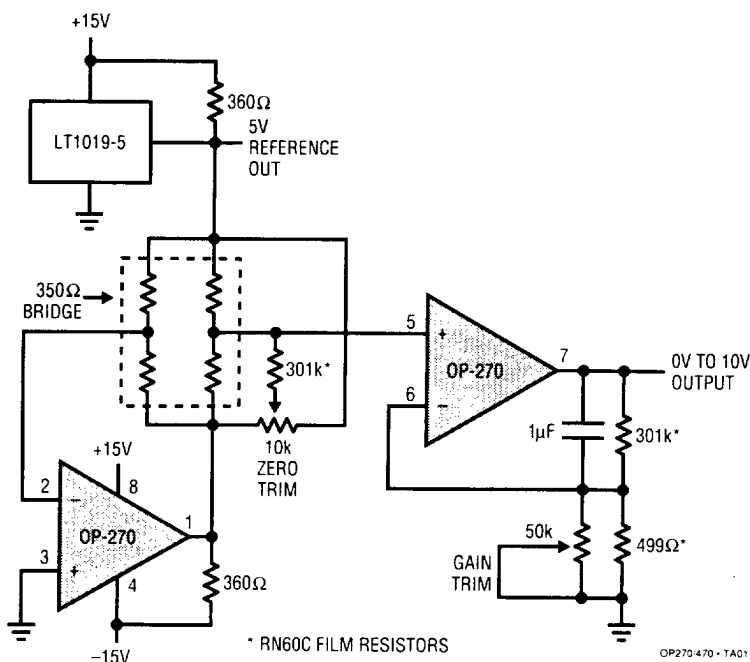
## DESCRIPTION

The OP-270 dual and OP-470 quad are high performance op amps with 80nVp-p noise, from 0.1Hz to 10Hz, offering comparable performance to the industry standard OP-27.

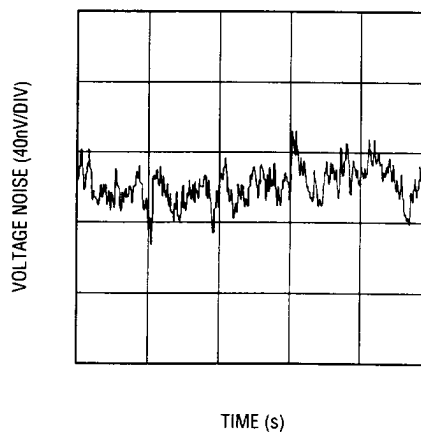
The OP-270 (OP-470) feature input offset voltage below 75μV (400μV) and offset drift under 1μV/°C (2μV/°C), guaranteed over the full military temperature range. Open-loop gain of the OP-270 (OP-470) is over 1.5 million (1.0 million) into a 10kΩ load ensuring excellent gain accuracy and linearity, even in high-gain applications. Input bias current is under ±20nA (±25nA) which reduces errors due to signal source resistance. The OP-270's (OP-470's) CMRR of over 106dB (110dB) and PSRR of less than 3.2μV/V (1.8μV/V) significantly reduce errors due to ground noise and power supply fluctuations. Power consumption of the dual OP-270 (quad OP-470) is one-third less than two (four) OP-27's, a significant advantage for power conscious applications. The OP-270 and OP-470 are unity-gain stable with a gain bandwidth product of 6MHz and a slew rate of 3.0V/μs.

For applications requiring higher performance, see the LT1124 and LT1125 data sheets.

### Strain Gauge Signal Conditioner with Bridge Excitation



### 0.1Hz to 10Hz Voltage Noise



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage .....	±18V
Differential Input Voltage (Note 4) .....	±1.0V
Differential Input Current (Note 4) .....	±25mA
Input Voltages .....	Equal to Supply Voltages
Output Short Circuit Duration .....	Indefinite

## Operating Temperature Range

OP270A/OP470A .....	-55°C to 125°C
OP270E/OP470E .....	-40°C to 85°C
OP270G/OP470G .....	-40°C to 85°C
Storage Temperature Range	
All Grades .....	-65°C to 150°C
Lead Temperature (Soldering, 10 sec.) .....	300°C

## PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>J8 PACKAGE 8-LEAD CERAMIC DIP N8 PACKAGE 8-LEAD PLASTIC DIP</p> <p>OP270/470 - PO103</p>	<p>TOP VIEW</p> <p>J PACKAGE 14-LEAD CERAMIC DIP N PACKAGE 14-LEAD PLASTIC DIP</p> <p>OP270/470 - PO102</p>	<p>TOP VIEW</p> <p>S PACKAGE 16-LEAD PLASTIC SOL</p> <p>OP270/470 - PO101</p>
ORDER PART NUMBER	ORDER PART NUMBER	ORDER PART NUMBER
OP-270AJ8 OP-270EJ8 OP-270GN8	OP-470AJ OP-470EJ OP-470GN	OP-470GS

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## ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, T_A = 25^\circ C$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	OP-270A/E			OP-470A/E			OP-270G OP-470G			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	OP-270 OP-470		10	75				50	250		$\mu V$
$I_{OS}$	Input Offset Current	OP-270 $V_{CM} = 0V$ OP-470 $V_{CM} = 0V$		5	15				6	20		nA
$I_B$	Input Bias Current	$V_{CM} = 0V$		±7	±20				±15	±60		nA
$e_n$ p-p	Input Noise Voltage	0.1Hz to 10Hz (Note 1)		80	200				80	200		nVp-p
$e_n$	Input Noise Voltage Density	$f_0 = 10Hz$ (Note 2) $f_0 = 100Hz$ (Note 2) $f_0 = 1000Hz$ (Note 2)		3.6	6.5				3.6	6.5		nV/ $\sqrt{Hz}$
				3.2	5.5				3.2	5.5		nV/ $\sqrt{Hz}$
				3.2	5.0				3.2	5.0		nV/ $\sqrt{Hz}$

# OP-270/OP-470

## ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$ , $T_A = 25^\circ C$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	OP-270A/E			OP-470A/E			OP-270G OP-470G			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$i_n$	Input Noise Current Density	$f_0 = 10\text{Hz}$ $f_0 = 100\text{Hz}$ $f_0 = 1000\text{Hz}$		1.5 0.5 0.4			1.5 0.5 0.4			1.5 0.5 0.4	$\text{pA}/\sqrt{\text{Hz}}$ $\text{pA}/\sqrt{\text{Hz}}$ $\text{pA}/\sqrt{\text{Hz}}$	
$A_{VOL}$	Large Signal Voltage Gain	$V_{OUT} = \pm 10V$ , $R_L = 10\text{k}\Omega$ $V_{OUT} = \pm 10V$ , $R_L = 2\text{k}\Omega$	1500 750	5000 2000		1000 500	5000 2000		800 400	2000 1000	$\text{V}/\text{mV}$ $\text{V}/\text{mV}$	
$V_{CM}$	Input Voltage Range	(Note 3)	$\pm 12$	$\pm 12.5$		$\pm 12$	$\pm 12.5$		$\pm 12$	$\pm 12.5$	V	
$V_{OUT}$	Output Voltage Swing	$R_L \geq 2\text{k}\Omega$	$\pm 12$	$\pm 13.5$		$\pm 12$	$\pm 13.5$		$\pm 12$	$\pm 13.5$	V	
CMRR	Common Mode Rejection Ratio	$V_{CM} = \pm 12V$	106	125		110	125		100	120	dB	
PSRR	Power Supply Rejection Ratio	$V_S = \pm 4.5V$ to $\pm 18V$		0.56 3.2			0.56 1.8			1.0 5.6	$\mu\text{V}/\text{V}$	
SR	Slew Rate		1.7	3.0		1.7	3.0		1.7	3.0	$\text{V}/\mu\text{s}$	
$I_S$	Supply Current	OP-270 No Load OP-470 No Load		4.5 6.5			9.0 11.0			4.0 6.5 9.0 11.0	mA mA	
GBW	Gain Bandwidth Product	$A_V = +10$		6			6			6	MHz	
CS	Channel Separation	$V_{OUT} = 20\text{Vp-p}$ , $f_0 = 10\text{Hz}$ (Note 1)	125	175		125	175		125	175	dB	
$C_{IN}$	Input Capacitance			3			3			3	pF	

## ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$ , $-55^\circ C \leq T_A \leq 125^\circ C$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		OP-270A			OP-470A			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage		●	30	175		140	600	$\mu\text{V}$	
$\frac{\Delta V_{OS}}{\Delta \text{Temp}}$	Average Input Offset Voltage Drift		●	0.2	1.0		0.4	2.0	$\mu\text{V}/^\circ\text{C}$	
$I_{OS}$	Input Offset Current	$V_{CM} = 0V$	●	10	45		10	55	nA	
$I_B$	Input Bias Current	$V_{CM} = 0V$	●	$\pm 15$	$\pm 60$		$\pm 15$	$\pm 50$	nA	
$A_{VOL}$	Large Signal Voltage Gain	$R_L \geq 10\text{k}\Omega$ , $V_{OUT} = \pm 10V$ $R_L \geq 2\text{k}\Omega$ , $V_{OUT} = \pm 10V$	● ●	750 400	3000 1500		750 400	3000 1500	$\text{V}/\text{mV}$ $\text{V}/\text{mV}$	
$V_{CM}$	Input Voltage Range	(Note 3)	●	$\pm 11$	$\pm 12$		$\pm 11$	$\pm 12$	V	
$V_{OUT}$	Output Voltage Swing	$R_L \geq 2\text{k}\Omega$	●	$\pm 12$	$\pm 13$		$\pm 12$	$\pm 13$	V	
CMRR	Common Mode Rejection Ratio	$V_{CM} = \pm 11V$	●	100	120		100	120	dB	
PSRR	Power Supply Rejection Ratio	$V_S = \pm 4.5V$ to $\pm 18V$	●		1.0 5.6			1.0 5.6	$\mu\text{V}/\text{V}$	
$I_S$	Supply Current All Amplifiers	No Load	●		5.0 7.5			10 13	mA	

The ● denotes the specifications which apply over the full operating temperature range.

**Note 1:** This parameter is guaranteed but not 100% tested.

**Note 2:** This parameter is sample tested only.

**Note 3:** This parameter is guaranteed by the CMRR test.

**Note 4:** The inputs are protected by back-to-back diodes. Current limiting resistors are not used in order to achieve low noise. If differential input voltage exceeds  $\pm 1.4V$ , the input current should be limited to 25mA.

**ELECTRICAL CHARACTERISTICS**  $V_S = \pm 15V, -40^\circ C \leq T_A \leq 85^\circ C$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	OP-270E			OP-470E			OP-270G OP-470G			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	OP-270	●	25	150			100	400	$\mu V$		
		OP-470	●			120	500	500	1500	$\mu V$		
$\frac{\Delta V_{OS}}{\Delta Temp}$	Average Input Offset Voltage Drift	OP-270	●	0.2	1.0			0.7	3.0	$\mu V/^\circ C$		
		OP-470	●			0.4	2.0	2.0		$\mu V/^\circ C$		
$I_{OS}$	Input Offset Current	$V_{CM} = 0V$	●	15	30	17	20	17	50	nA		
$I_B$	Input Bias Current	$V_{CM} = 0V$	●	$\pm 15$	$\pm 60$	$\pm 17$	$\pm 50$	$\pm 18$	$\pm 75$	nA		
$A_{VOL}$	Large Signal Voltage Gain	$V_{OUT} = \pm 10V, R_L \geq 10k\Omega$	●	1000	2000	800	2000	600	1500	V/mV		
		$V_{OUT} = \pm 10V, R_L \geq 2k\Omega$	●	500	1000	400	1000	300	800	V/mV		
$V_{CM}$	Input Voltage Range	(Note 3)	●	$\pm 11$	$\pm 12$	$\pm 11$	$\pm 12$	$\pm 11$	$\pm 12$	V		
$V_{OUT}$	Output Voltage Swing	$R_L \geq 2k\Omega$	●	$\pm 12$	$\pm 13$	$\pm 12$	$\pm 13$	$\pm 12$	$\pm 13$	V		
CMRR	Common Mode Rejection Ratio	$V_{CM} = \pm 11V$	●	100	120	100	120	90	110	dB		
PSRR	Power Supply Rejection Ratio	$V_S = \pm 4.5V$ to $\pm 18V$	●	0.7	5.6	0.7	5.6	1.8	10	$\mu V/V$		
$I_S$	Supply Current All Amplifiers	OP-270 No Load	●	4.8	7.2			4.8	7.2	mA		
		OP-470 No Load	●			9.6	13	9.6	13	mA		

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**TYPICAL PERFORMANCE CHARACTERISTICS**

