

Dual/Quad Low Noise, Precision Operational Amplifiers

FEATURES

- Low Noise
- Input Offset Voltage
- Low Offset Voltage Drift
- Very High Gain
- Outstanding CMRR
- Slew Rate
- Gain Bandwidth Product
- Industry Standard Pinouts

$5\text{nV}/\sqrt{\text{Hz}}$ @ 1kHz Max
 OP-270: $75\mu\text{V}$ Max
 OP-470: $400\mu\text{V}$ Max
 OP-270: $1\mu\text{V}/^\circ\text{C}$ Max
 OP-470: $2\mu\text{V}/^\circ\text{C}$ Max
 OP-270: $1500\text{V}/\text{mV}$ Min
 OP-470: $1000\text{V}/\text{mV}$ Min
 OP-270: 106dB Min
 OP-470: 110dB Min
 $3.0\text{V}/\mu\text{s}$ Typ
 6MHz Typ

APPLICATIONS

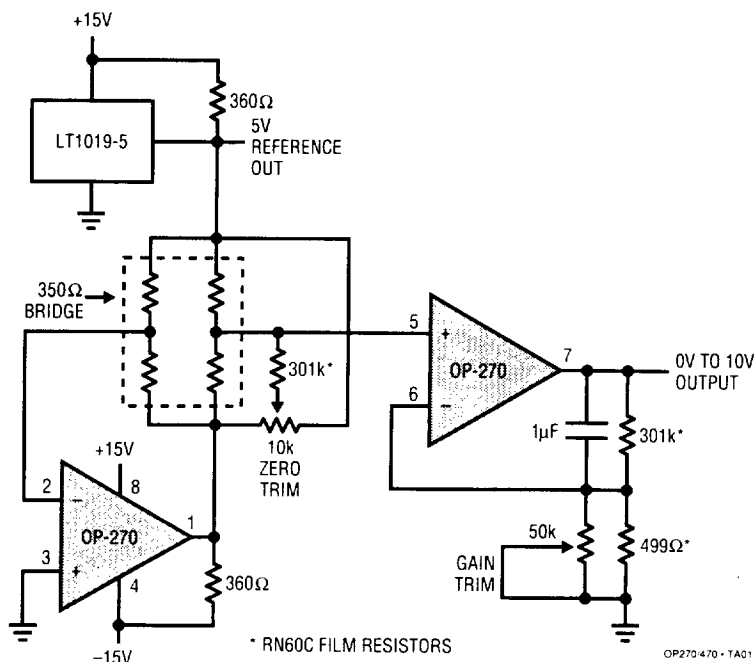
- Two and Three Op Amp Instrumentation Amplifiers
- Low Noise Signal Processing
- Microvolt Accuracy Threshold Detection
- Strain Gauge Amplifiers
- Accelerometer Amplifiers
- Infrared Detectors

DESCRIPTION

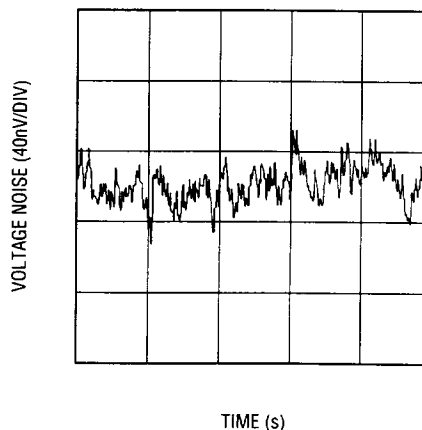
The OP-270 dual and OP-470 quad are high performance op amps with 80nVp-p noise, from 0.1Hz to 10Hz, offering comparable performance to the industry standard OP-27. The OP-270 (OP-470) feature input offset voltage below $75\mu\text{V}$ ($400\mu\text{V}$) and offset drift under $1\mu\text{V}/^\circ\text{C}$ ($2\mu\text{V}/^\circ\text{C}$), 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 $10\text{k}\Omega$ load ensuring excellent gain accuracy and linearity, even in high-gain applications. Input bias current is under $\pm 20\text{nA}$ ($\pm 25\text{nA}$) 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 $3.2\mu\text{V}/\text{V}$ ($1.8\mu\text{V}/\text{V}$) 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 $3.0\text{V}/\mu\text{s}$.

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	
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

J8 PACKAGE 8-LEAD CERAMIC DIP N8 PACKAGE 8-LEAD PLASTIC DIP OP270/470 - PO103	J PACKAGE 14-LEAD CERAMIC DIP N PACKAGE 14-LEAD PLASTIC DIP OP270/470 - PO102	S PACKAGE 16-LEAD PLASTIC SOL OP270/470 - PO101
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		μV
						100	400		400	1000		μV
I_{OS}	Input Offset Current	OP-270 $V_{CM} = 0V$ OP-470 $V_{CM} = 0V$		5	15				6	20		nA
						6	20		12	30		nA
I_B	Input Bias Current	$V_{CM} = 0V$		±7	±20		±7	±25		±15	±60	nA
e_n p-p	Input Noise Voltage	0.1Hz to 10Hz (Note 1)		80	200		80	200		80	200	nVp-p
e_n	Input Noise Voltage Density	$f_0 = 10Hz$ (Note 2)		3.6	6.5		3.6	6.5		3.6	6.5	nV/ $\sqrt{Hz}$
		$f_0 = 100Hz$ (Note 2)		3.2	5.5		3.2	5.5		3.2	5.5	nV/ $\sqrt{Hz}$
		$f_0 = 1000Hz$ (Note 2)		3.2	5.0		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	$V_{OUT} = \pm 10V$, $R_L = 10k\Omega$ $V_{OUT} = \pm 10V$, $R_L = 2k\Omega$	1500 750	5000 2000		1000 500	5000 2000		800 400	2000 1000		V/mV V/mV
V_{CM}	Input Voltage Range	(Note 3)	± 12	± 12.5		± 12	± 12.5		± 12	± 12.5		V
V_{OUT}	Output Voltage Swing	$R_L \geq 2k\Omega$	± 12	± 13.5		± 12	± 13.5		± 12	± 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	$\mu V/V$
SR	Slew Rate		1.7	3.0		1.7	3.0		1.7	3.0		$V/\mu s$
I_S	Supply Current	OP-270 No Load OP-470 No Load		4.5	6.5		9.0	11.0		4.0	6.5	mA mA
GBW	Gain Bandwidth Product	$A_V = +10$		6			6			6		MHz
CS	Channel Separation	$V_{OUT} = 20Vp-p$, $f_0 = 10\text{Hz}$ (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		μV
$\frac{\Delta V_{OS}}{\Delta \text{Temp}}$	Average Input Offset Voltage Drift		●	0.2	1.0		0.4	2.0		$\mu V/^\circ C$
I_{OS}	Input Offset Current	$V_{CM} = 0V$	●	10	45		10	55		nA
I_B	Input Bias Current	$V_{CM} = 0V$	●	± 15	± 60		± 15	± 50		nA
A_{VOL}	Large Signal Voltage Gain	$R_L \geq 10k\Omega$, $V_{OUT} = \pm 10V$ $R_L \geq 2k\Omega$, $V_{OUT} = \pm 10V$	● ●	750 400	3000 1500		750 400	3000 1500		V/mV V/mV
V_{CM}	Input Voltage Range	(Note 3)	●	± 11	± 12		± 11	± 12		V
V_{OUT}	Output Voltage Swing	$R_L \geq 2k\Omega$	●	± 12	± 13		± 12	± 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		$\mu V/V$
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		μV
		OP-470	●				120	500		500	1500		μV
$\frac{\Delta V_{OS}}{\Delta Temp}$	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	$V_{CM} = 0V$	●	± 15	± 60		± 17	± 50		± 18	± 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)	●	± 11	± 12		± 11	± 12		± 11	± 12		V
V_{OUT}	Output Voltage Swing	$R_L \geq 2k\Omega$	●	± 12	± 13		± 12	± 13		± 12	± 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

