



Single/Dual/Quad, 28MHz, Low-Noise, Low-Voltage, Precision Op Amps

General Description

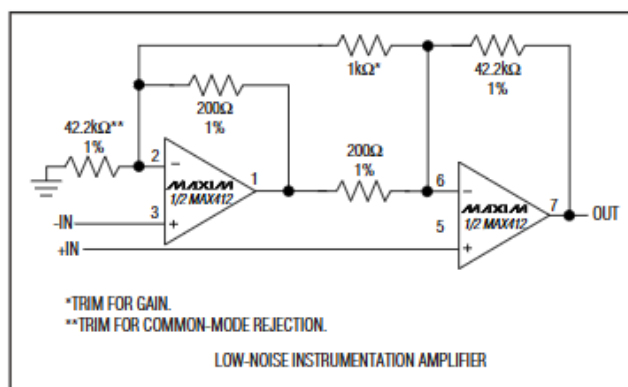
The MAX410/MAX412/MAX414 single/dual/quad op amps set a new standard for noise performance in high-speed, low-voltage systems. Input voltage-noise density is guaranteed to be less than $2.4\text{nV}/\sqrt{\text{Hz}}$ at 1kHz. A unique design not only combines low noise with $\pm 5\text{V}$ operation, but also consumes 2.5mA supply current per amplifier. Low-voltage operation is guaranteed with an output voltage swing of $7.3\text{V}_{\text{P-P}}$ into $2\text{k}\Omega$ from $\pm 5\text{V}$ supplies. The MAX410/MAX412/MAX414 also operate from supply voltages between $\pm 2.4\text{V}$ and $\pm 5\text{V}$ for greater supply flexibility.

Unity-gain stability, 28MHz bandwidth, and $4.5\text{V}/\mu\text{s}$ slew rate ensure low-noise performance in a wide variety of wideband and measurement applications. The MAX410/MAX412/MAX414 are available in DIP and SO packages in the industry-standard single/dual/quad op amp pin configurations. The single comes in an ultra-small TDFN package (3mm x 3mm).

Applications

Low-Noise Frequency Synthesizers
Infrared Detectors
High-Quality Audio Amplifiers
Ultra Low-Noise Instrumentation Amplifiers
Bridge Signal Conditioning

Typical Operating Circuit



Features

- ◆ Voltage Noise: $2.4\text{nV}/\sqrt{\text{Hz}}$ (max) at 1kHz
- ◆ 2.5mA Supply Current Per Amplifier
- ◆ Low Supply Voltage Operation: $\pm 2.4\text{V}$ to $\pm 5\text{V}$
- ◆ 28MHz Unity-Gain Bandwidth
- ◆ $4.5\text{V}/\mu\text{s}$ Slew Rate
- ◆ $250\mu\text{V}$ (max) Offset Voltage (MAX410/MAX412)
- ◆ 115dB (min) Voltage Gain
- ◆ Available in an Ultra-Small TDFN Package

Ordering Information

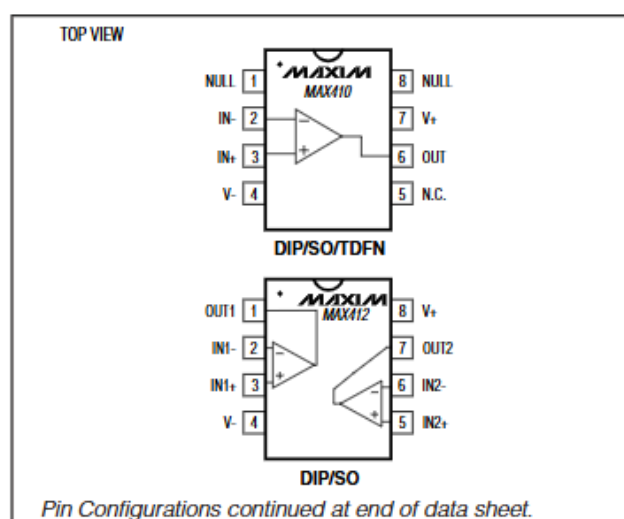
PART	TEMP RANGE	PIN-PACKAGE
MAX410CPA	0°C to $+70^{\circ}\text{C}$	8 Plastic DIP
MAX410BCPA	0°C to $+70^{\circ}\text{C}$	8 Plastic DIP
MAX410CSA	0°C to $+70^{\circ}\text{C}$	8 SO
MAX410BCSA	0°C to $+70^{\circ}\text{C}$	8 SO
MAX410EPA	-40°C to $+85^{\circ}\text{C}$	8 Plastic DIP
MAX410BEPA	-40°C to $+85^{\circ}\text{C}$	8 Plastic DIP
MAX410ESA	-40°C to $+85^{\circ}\text{C}$	8 SO
MAX410BESA	-40°C to $+85^{\circ}\text{C}$	8 SO
MAX410ETA	-40°C to $+85^{\circ}\text{C}$	8 TDFN-EP*
MAX410MSA/PR	-55°C to $+125^{\circ}\text{C}$	8 SO**
MAX410MSA/PR-T	-55°C to $+125^{\circ}\text{C}$	8 SO**

*EP = Exposed pad. Top Mark—AGQ.

**Contact factory for availability.

Ordering Information continued at end of data sheet.

Pin Configurations



MAX410/MAX412/MAX414



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ABSOLUTE MAXIMUM RATINGS

Supply Voltage 12V
 Differential Input Current (Note 1) $\pm 20\text{mA}$
 Input Voltage Range V_+ to V_-
 Common-Mode Input Voltage $(V_+ + 0.3\text{V})$ to $(V_- - 0.3\text{V})$
 Short-Circuit Current Duration Continuous
 Continuous Power Dissipation ($T_A = +70^\circ\text{C}$)
 MAX410/MAX412
 8-Pin Plastic DIP (derate $9.09\text{mW}/^\circ\text{C}$ above $+70^\circ\text{C}$) ... 727mW
 8-Pin SO (derate $5.88\text{mW}/^\circ\text{C}$ above $+70^\circ\text{C}$) 471mW
 8-Pin TDFN (derate $18.5\text{mW}/^\circ\text{C}$ above $+70^\circ\text{C}$) 1482mW

MAX414

14-Pin Plastic DIP (derate $10.00\text{mW}/^\circ\text{C}$ above $+70^\circ\text{C}$) 800mW
 14-Pin SO (derate $8.33\text{mW}/^\circ\text{C}$ above $+70^\circ\text{C}$) 667mW
 Operating Temperature Ranges:
 MAX41_C 0°C to $+70^\circ\text{C}$
 MAX41_E -40°C to $+85^\circ\text{C}$
 MAX41_M -55°C to $+125^\circ\text{C}$
 Storage Temperature Range -65°C to $+150^\circ\text{C}$
 Lead Temperature (soldering, 10s) $+300^\circ\text{C}$

Note 1: The amplifier inputs are connected by internal back-to-back clamp diodes. In order to minimize noise in the input stage, current-limiting resistors are not used. If differential input voltages exceeding $\pm 1.0\text{V}$ are applied, limit input current to 20mA .

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

($V_+ = 5\text{V}$, $V_- = -5\text{V}$, $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Offset Voltage	V_{OS}	MAX410, MAX410B, MAX412, MAX412B			± 120	± 250	μV
		MAX414, MAX414B			± 150	± 320	
Input Bias Current	I_B				± 80	± 150	nA
Input Offset Current	I_{OS}				± 40	± 80	nA
Differential Input Resistance	$R_{IN(DIFF)}$				20		$k\Omega$
Common-Mode Input Resistance	$R_{IN(CM)}$				40		$M\Omega$
Input Capacitance	C_{IN}				4		pF
Input Noise-Voltage Density	e_n	MAX410, MAX412, MAX414	10Hz		7		$nV/\sqrt{\text{Hz}}$
			1000Hz (Note 2)		1.5	2.4	
		MAX410B, MAX412B, MAX414B	1000Hz (Note 2)		2.4	4.0	
Input Noise-Current Density	i_n	$f_O = 10\text{Hz}$			2.6		$pA/\sqrt{\text{Hz}}$
		$f_O = 1000\text{Hz}$			1.2		
Common-Mode Input Voltage	V_{CM}			± 3.5	$+3.7/-3.8$		V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 3.5\text{V}$		115	130		dB
Power-Supply Rejection Ratio	PSRR	$V_S = \pm 2.4\text{V}$ to $\pm 5.25\text{V}$		96	103		dB
Large-Signal Gain	A_{VOL}	$R_L = 2k\Omega$, $V_O = \pm 3.6\text{V}$		115	122		dB
		$R_L = 600\Omega$, $V_O = \pm 3.5\text{V}$		110	120		
Output Voltage Swing	V_{OUT}	$R_L = 2k\Omega$		$+3.6/-3.7$	$+3.7/-3.8$		V
Short-Circuit Output Current	I_{SC}				35		mA
Slew Rate	SR	10k Ω 20pF load			4.5		V/ μs
Unity-Gain Bandwidth	GBW	10k Ω 20pF load			28		MHz
Settling Time	t_S	To 0.1%			1.3		μs
Channel Separation	C_S	$f_O = 1\text{kHz}$			135		dB