Precision, Single Supply Op Amp

FEATURES

- Single Supply Operation
  - Input Voltage Range Extends to Ground
  - Output Swings to Ground while Sinking Current
- *Guaranteed* Offset Voltage 400μV Max.
- *Guaranteed* Low Drift 3.5μV/°C Max.
- *Guaranteed* Offset Current 0.9nA Max.
- *Guaranteed* High Gain
  - 5mA Load Current 1.2 Million Min.
  - 17mA Load Current 0.5 Million Min.
- *Guaranteed* Low Supply Current 570μA Max.
- Supply Current can be Reduced by a Factor of 4
- Low Voltage Noise, 0.1Hz to 10Hz 0.55μVp-p
- Low Current Noise—
  - Better than OP-07 0.08pA/$\sqrt{Hz}$ at 10Hz
- High Input Impedance 100MΩ Min.
- *Guaranteed* Minimum Supply Voltage 2.7V Min.

APPLICATIONS

- Low Power Sample and Hold Circuits
- Battery Powered Precision Instrumentation
  - Strain Gauge Signal Conditioners
  - Thermocouple Amplifiers
- 4mA-20mA Current Loop Transmitters
- Active Filters

DESCRIPTION

The LT1006S8 is the first precision single supply operational amplifier. Its design has been optimized for single supply operation with a full set of specifications at 5V. Specifications at ±15V are also provided.

The LT1006S8 has low offset voltage of 80μV, drift of 0.7μV/°C, offset current of 150pA, gain of 2 million, common-mode rejection of 112dB, and power supply rejection of 126dB.

Although supply current is only 350μA, a novel output stage can source or sink in excess of 20mA while retaining high voltage gain. Common-mode input range includes ground to accommodate low ground-referenced inputs from strain gauges or thermocouples, and output can swing to within a few millivolts of ground. If higher slew rate (in excess of 1V/μs) or micropower operation (supply current down to 90μA) is required, the operating currents can be modified by connecting an external optional resistor to Pin 8.

For a similar single supply precision dual op amp in the SO package, please see the LT1013DS8 data sheet.

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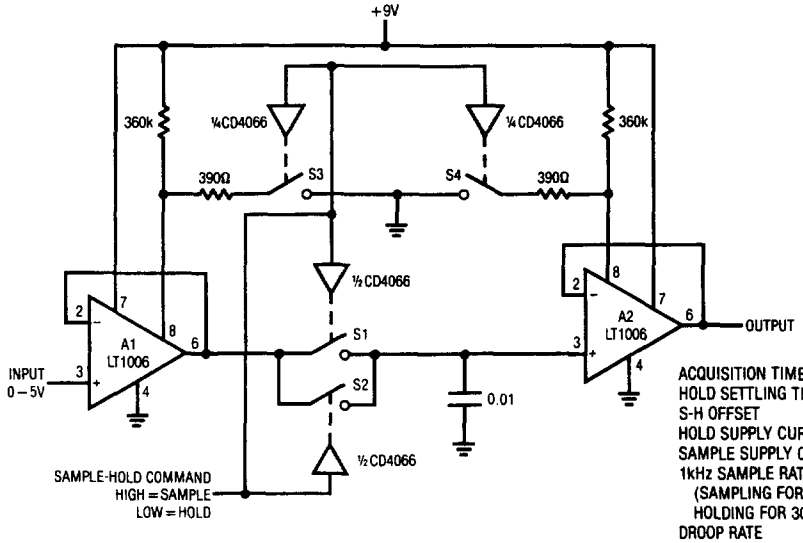
LT1006 Single Supply, Micropower Sample and Hold

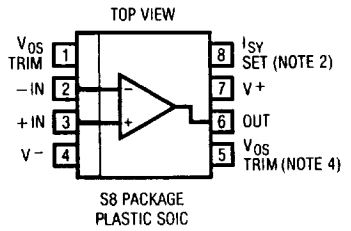


ACQUISITION TIME	20μs
HOLD SETTLING TIME	10μs
S-H OFFSET	1mV
HOLD SUPPLY CURRENT	250μA
SAMPLE SUPPLY CURRENT	5.0mA
1kHz SAMPLE RATE CURRENT (SAMPLING FOR 20μs, HOLDING FOR 300μs)	800μA
DROOP RATE	0.5mV/ms

ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... ±22V
Input Voltage ..... Equal to Positive Supply Voltage
..... 5V Below Negative Supply Voltage
Differential Input Voltage..... 30V
Output Short Circuit Duration ..... Indefinite
Operating Temperature Range ..... 0°C to 70°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



S8 PACKAGE
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ORDER PART NUMBER
LT1006S8
PART MARKING
1006

ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V, V_{CM} = 0V, V_{OUT} = 1.4V, T_A = 25°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1006S8 MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage			80	400	µV
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			0.7		µV/Mo
I_{OS}	Input Offset Current			0.15	0.9	nA
I_B	Input Bias Current			10	25	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz		0.55		µVp-p
	Input Noise Voltage Density	f_o = 10Hz (Note 3) f_o = 1000Hz (Note 3)		23 22	32 25	nV/√Hz nV/√Hz
i_n	Input Noise Current Density	f_o = 10Hz		0.08		pA/√Hz
	Input Resistance Differential Mode Common-Mode	(Note 1)	 100	 300 4		 MΩ GΩ
	Input Voltage Range		3.5 0	3.8 –0.3		V V
CMRR	Common-Mode Rejection Ratio	V_{CM} = 0V to 3.5V	97	112		dB
PSRR	Power Supply Rejection Ratio	V_S = ±2V to ±18V, V_O = 0V	103	124		dB
A_{VOL}	Large Signal Voltage Gain	V_O = 0.03V to 4V, R_L = 10k V_O = 0.03V to 3.5V, R_L = 2k	0.7 0.3	2.0 1.8		V/µV V/µV
V_{OUT}	Maximum Output Voltage Swing	Output Low, No Load Output Low, 600Ω to GND Output Low, I_{SINK} = 1mA Output High, No Load Output High, 600Ω to GND	 4.0 3.4	15 5 220 4.4 4.0	25 10 350 	mV mV mV V V
SR	Slew Rate		0.25	0.4		V/µs
I_S	Supply Current	R_{SET} = ∞ R_{SET} = 180k Pin 8 to Pin 7 (Note 2)		350 90	570 	µA µA
	Minimum Supply Voltage		2.7			V

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

SYMBOL	PARAMETER	CONDITIONS	LT1006S8 MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage			100	525	μV
I_{OS}	Input Offset Current			0.15	0.9	nA
I_B	Input Bias Current			8.0	20.0	nA
	Input Voltage Range		13.5 −15.0	13.8 −15.3		V V
CMRR	Common-Mode Rejection Ratio	$V_{CM} = +13.5V, -15V$	97	116		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 18V$, $V_O = 0V$	103	124		dB
A_{VOL}	Large Signal Voltage Gain	$V_O = \pm 10V$, $R_L = 2k$ $V_O = \pm 10V$, $R_L = 600\Omega$	1.2 0.5	4.0 1.0		V/μV V/μV
V_{OUT}	Maximum Output Voltage Swing	$R_L = 2k$	±12.5	±14		V
SR	Slew Rate	$R_{SET} = \infty$ $R_{SET} = 390\Omega$ Pin 8 to Pin 4	0.25 1.0	0.4 1.2		V/μs V/μs
I_S	Supply Current			360	600	μA

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ELECTRICAL CHARACTERISTICS

$V_S = 5V, 0V$, $V_{CM} = 0V$, $V_{OUT} = 1.4V$, $0°C \le T_A \le 70°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1006S8 MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage		●		110	560	μV
$\frac{\Delta V_{OS}}{\Delta Temp}$	Input Offset Voltage Drift		●		0.7	3.5	μV/°C
I_{OS}	Input Offset Current		●		0.3	2.5	nA
I_B	Input Bias Current		●		12	30	nA
A_{VOL}	Large Signal Voltage Gain	$V_O = 0.04V$ to $3.5V$, $R_L = 2k$	●	0.25	1.2		V/μV
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0V$ to $3.4V$	●	92	108		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 18V$, $V_O = 0V$	●	97	118		dB
V_{OUT}	Maximum Output Voltage Swing	Output Low, 600Ω to GND Output High, 600Ω to GND	● ●	 3.2	6 3.9	13	mV V
I_S	Supply Current		●		360	620	μA

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, 0°C \leq T_A \leq 70°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1006S8 MIN	LT1006S8 TYP	LT1006S8 MAX	UNITS
V_{OS}	Input Offset Voltage		●		150	730	μV
$\frac{\Delta V_{OS}}{\Delta Temp}$	Input Offset Voltage Drift		●		1.0	4.5	μV/°C
I_{OS}	Input Offset Current		●		0.25	2.0	nA
I_B	Input Bias Current		●		10	23	nA
A_{VOL}	Large Signal Voltage Gain	$V_O = \pm 10V, R_L = 2k$	●	0.7	2.5		V/μV
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 13V, -15V$	●	94	114		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2V$ to $\pm 18V, V_O = 0V$	●	97	118		dB
V_{OUT}	Maximum Output Voltage Swing	$R_L = 2k$	●	±11.5	±13.8		V
I_S	Supply Current		●		380	660	μA

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

Note 1: This parameter is guaranteed by design and is not tested.

Note 2: Regular operation does not require an external resistor. In order to program the supply current for low power or high speed operation, connect an external resistor from Pin 8 to Pin 7 or from Pin 8 to Pin 4, respectively. Supply current specifications (for $R_{SET} = 180k$) do not include current in R_{SET}.

Note 3: This parameter is tested on a sample basis only. All noise parameters are tested with $V_S = \pm 2.5V, V_O = 0V$.

Note 4: Optional offset nulling is accomplished with a potentiometer connected between the trim terminals and the wiper to V^-. A 10k pot (providing a null range of ±6mV) is recommended for minimum drift of nulled offset voltage with temperature. For increased trim resolution and accuracy, two fixed resistors can be used in conjunction with a smaller potentiometer. For example: two 4.7k resistors tied to pins 1 and 5, with a 500Ω pot in the middle, will have a null range of ±150μV.