

## FEATURES

- Single Supply Operation  
 Input Voltage Range Extends to Ground  
 Output Swings to Ground while Sinking Current
- *Guaranteed* Offset Voltage                      400 $\mu$ V Max.
- *Guaranteed* Low Drift                              3.5 $\mu$ V/ $^{\circ}$ 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              570 $\mu$ A Max.
- Supply Current can be Reduced by a Factor of 4
- Low Voltage Noise, 0.1Hz to 10Hz            0.55 $\mu$ Vp-p
- Low Current Noise—  
 Better than OP-07                              0.08pA/ $\sqrt{\text{Hz}}$  at 10Hz
- High Input Impedance                            100M $\Omega$  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

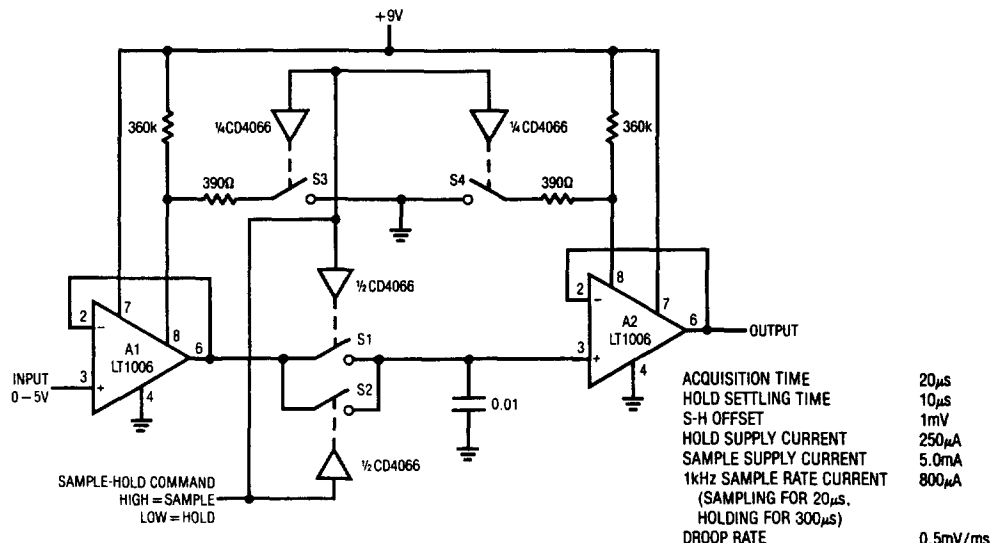
## DESCRIPTION

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  $\pm 15$ V are also provided.

The LT1006S8 has low offset voltage of 80 $\mu$ V, drift of 0.7 $\mu$ V/ $^{\circ}$ 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 350 $\mu$ A, 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/ $\mu$ s) or micropower operation (supply current down to 90 $\mu$ A) is required, the operating currents can be modified by connecting an external optional resistor to Pin 8.

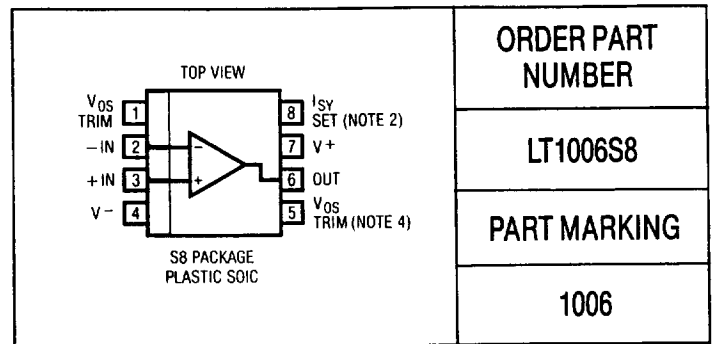
For a similar single supply precision dual op amp in the SO package, please see the LT1013DS8 data sheet.

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**LT1006 Single Supply, Micropower Sample and Hold**


**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage .....  $\pm 22V$   
 Input Voltage ..... Equal to Positive Supply Voltage  
 ..... 5V Below Negative Supply Voltage  
 Differential Input Voltage..... 30V  
 Output Short Circuit Duration ..... Indefinite  
 Operating Temperature Range .....  $0^{\circ}C$  to  $70^{\circ}C$   
 Storage Temperature Range .....  $-65^{\circ}C$  to  $150^{\circ}C$   
 Lead Temperature (Soldering, 10 sec) .....  $300^{\circ}C$

**PACKAGE/ORDER INFORMATION**



**ELECTRICAL CHARACTERISTICS**

$V_S = 5V, 0V, V_{CM} = 0V, V_{OUT} = 1.4V, T_A = 25^{\circ}C$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1006S8			UNITS
			MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage			80	400	$\mu V$
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			0.7		$\mu V/Mo$
$I_{OS}$	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		$\mu Vp-p$
	Input Noise Voltage Density	$f_o = 10Hz$ (Note 3) $f_o = 1000Hz$ (Note 3)		23 22	32 25	$nV/\sqrt{Hz}$ $nV/\sqrt{Hz}$
$i_n$	Input Noise Current Density	$f_o = 10Hz$		0.08		$pA/\sqrt{Hz}$
	Input Resistance	(Note 1)				
	Differential Mode		100	300		M $\Omega$
	Common-Mode			4		G $\Omega$
	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	$V_S = \pm 2V$ to $\pm 18V, V_O = 0V$	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		$V/\mu V$ $V/\mu V$
$V_{OUT}$	Maximum Output Voltage Swing	Output Low, No Load Output Low, $600\Omega$ to GND Output Low, $I_{SINK} = 1mA$ Output High, No Load Output High, $600\Omega$ to GND		15 5 220 4.0 3.4	25 10 350 4.4 4.0	mV mV mV V V
SR	Slew Rate		0.25	0.4		$V/\mu s$
$I_S$	Supply Current	$R_{SET} = \infty$ $R_{SET} = 180k$ Pin 8 to Pin 7 (Note 2)		350 90	570	$\mu A$ $\mu A$
	Minimum Supply Voltage		2.7			V

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

SYMBOL	PARAMETER	CONDITIONS	LT1006S8			UNITS
			MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage			100	525	$\mu V$
$I_{OS}$	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		$V/\mu V$ $V/\mu V$
$V_{OUT}$	Maximum Output Voltage Swing	$R_L = 2k$	$\pm 12.5$	$\pm 14$		V
SR	Slew Rate	$R_{SET} = \infty$ $R_{SET} = 390\Omega$ Pin 8 to Pin 4	0.25 1.0	0.4 1.2		$V/\mu s$ $V/\mu s$
$I_S$	Supply Current			360	600	$\mu A$

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**ELECTRICAL CHARACTERISTICS**

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

SYMBOL	PARAMETER	CONDITIONS	LT1006S8			UNITS
			MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	●		110	560	$\mu V$
$\frac{\Delta V_{OS}}{\Delta Temp}$	Input Offset Voltage Drift	●		0.7	3.5	$\mu V/^\circ C$
$I_{OS}$	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	$V/\mu V$
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, $600\Omega$ to GND Output High, $600\Omega$ to GND	● ●	6 3.2	13	mV V
$I_S$	Supply Current	●		360	620	$\mu A$

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

SYMBOL	PARAMETER	CONDITIONS	LT1006S8			UNITS
			MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	●		150	730	$\mu V$
$\frac{\Delta V_{OS}}{\Delta Temp}$	Input Offset Voltage Drift	●		1.0	4.5	$\mu V/^\circ C$
$I_{OS}$	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	$V/\mu V$
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	$R_L = 2k$	●	$\pm 11.5$	$\pm 13.8$	V
$I_S$	Supply Current	●		380	660	$\mu A$

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  $\pm 6mV$ ) 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 500 $\Omega$  pot in the middle, will have a null range of  $\pm 150\mu V$ .