

Sample-and-hold amplifiers

LF198/LF298/LF398

DESCRIPTION

The LF198/LF298/LF398 are monolithic sample-and-hold circuits which utilize high-voltage ion-implant JFET technology to obtain ultra-high DC accuracy with fast acquisition of signal and low droop rate. Operating as a unity gain follower, DC gain accuracy is 0.002% typical and acquisition time is as low as 6μs to 0.01%. A bipolar input stage is used to achieve low offset voltage and wide bandwidth. Input offset adjust is accomplished with a single pin and does not degrade input offset drift. The wide bandwidth allows the LF198 to be included inside the feedback loop of 1MHz op amps without having stability problems. Input impedance of 10<sup>10</sup>Ω allows high source impedances to be used without degrading accuracy.

P-channel junction FETs are combined with bipolar devices in the output amplifier to give droop rates as low as 5mV/min with a 1μF hold capacitor. The JFETs have much lower noise than MOS devices used in previous designs and do not exhibit high temperature instabilities. The overall design guarantees no feedthrough from input to output in the hold mode even for input signals equal to the supply voltages.

Logic inputs are fully differential with low input current, allowing direct connection to TTL, PMOS, and CMOS; differential threshold is 1.4V. The LF198/LF298/LF398 will operate from ±5V to ±18V supplies. They are available in 8-pin plastic DIP, 8-pin Cerdip, and 14-pin plastic SO packages.

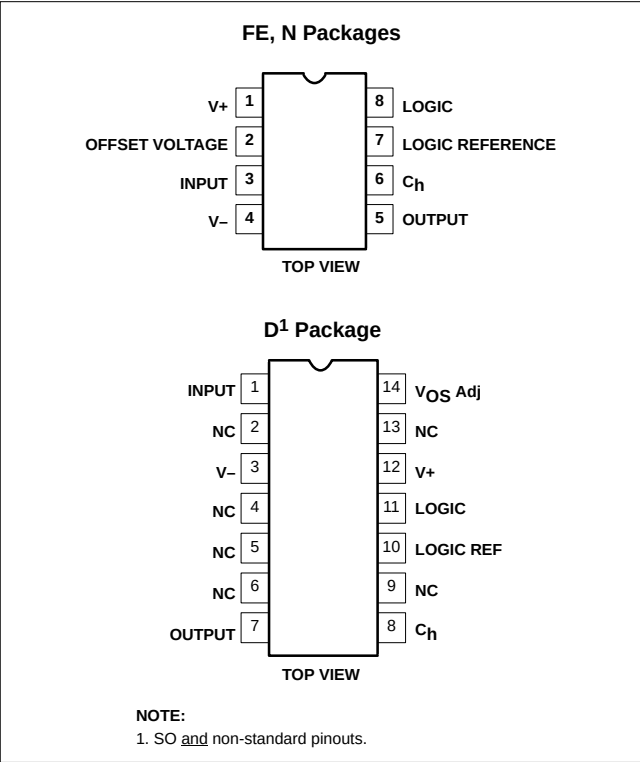
FEATURES

- Operates from ±5V to ±18V supplies
- Less than 10μs acquisition time
- TTL, PMOS, CMOS compatible logic input
- 0.5mV typical hold step at CH=0.01μF
- Low input offset
- 0.002% gain accuracy
- Low output noise in hold mode
- Input characteristics do not change during hold mode
- High supply rejection ratio in sample or hold
- Wide bandwidth

ORDERING INFORMATION

| DESCRIPTION                                 | TEMPERATURE RANGE | ORDER CODE | DWG # |
|---------------------------------------------|-------------------|------------|-------|
| 8-Pin Ceramic Dual In-Line Package (CERDIP) | -55°C to +125°C   | LF198FE    | 0580A |
| 14-Pin Plastic Small Outline (SO) Package   | 0 to +70°C        | LF398D     | 0175D |
| 8-Pin Ceramic Dual In-Line Package (CERDIP) | 0 to +70°C        | LF398FE    | 0580A |
| 8-Pin Plastic Dual In-Line Package (DIP)    | 0 to +70°C        | LF398N     | 0404B |
| 8-Pin Ceramic Dual In-Line Package (CERDIP) | -25°C to +85°C    | LF298FE    | 0580A |
| 8-Pin Plastic Dual In-Line Package (DIP)    | -25°C to +85°C    | LF298N     | 0404B |

PIN CONFIGURATIONS



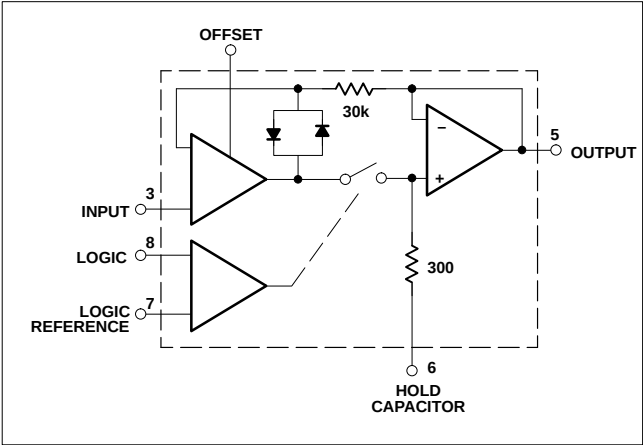
APPLICATION

- The LF198/LF298/LF398 are ideally suited for a wide variety of sample-and-hold applications, including data acquisition, analog-to-digital conversion, synchronous demodulation, and automatic test setup

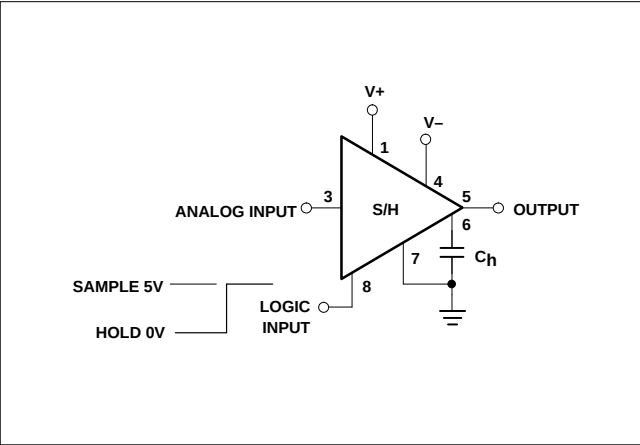
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FUNCTIONAL DIAGRAM



TYPICAL APPLICATIONS



ABSOLUTE MAXIMUM RATINGS

| SYMBOL            | PARAMETER                                                                  | RATING                  | UNIT |
|-------------------|----------------------------------------------------------------------------|-------------------------|------|
| V <sub>S</sub>    | Supply voltage                                                             | ±18                     | V    |
|                   | Maximum power dissipation<br>T <sub>A</sub> =25°C (still-air) <sup>3</sup> |                         |      |
|                   | F package                                                                  | 780                     | mW   |
|                   | N package                                                                  | 1160                    | mW   |
|                   | D package                                                                  | 1040                    | mW   |
| T <sub>A</sub>    | Operating ambient temperature range                                        |                         |      |
|                   | LF198                                                                      | -55 to +125             | °C   |
|                   | LF298                                                                      | -25 to +85              | °C   |
|                   | LF398                                                                      | 0 to +70                | °C   |
| T <sub>STG</sub>  | Storage temperature range                                                  | -65 to +150             | °C   |
| V <sub>IN</sub>   | Input voltage                                                              | Equal to supply voltage |      |
|                   | Logic-to-logic reference differential voltage <sup>2</sup>                 | +7, -30                 | V    |
|                   | Output short-circuit duration                                              | Indefinite              |      |
|                   | Hold capacitor short-circuit duration                                      | 10                      | sec  |
| T <sub>SOLD</sub> | Lead soldering temperature (10sec max)                                     | 300                     | °C   |

NOTES:

1. The maximum junction temperature of the LF398 is 150°C. When operating at elevated ambient temperature, the packages must be derated based on the thermal resistance specified.
2. Although the differential voltage may not exceed the limits given, the common-mode voltage on the logic pins must always be at least 2V below the positive supply and 3V above the negative supply.
3. Derate above 25°C, at the following rates:  
F package at 6.2mW/°C  
N package at 9.3mW/°C  
D package at 8.3mW/°C

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## DC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, the following conditions apply: unit is in "sample" mode;  $V_S = \pm 15V$ ;  $T_J = 25^\circ C$ ;  $-11.5V \leq V_{IN} \leq +11.5V$ ;  $C_H = 0.01\mu F$ ; and  $R_L = 10k\Omega$ . Logic reference voltage = 0V and logic voltage = 2.5V.

| SYMBOL     | PARAMETER                                        | TEST CONDITIONS                                              | LF198/LF298 |           |               | LF398 |           |              | UNIT     |
|------------|--------------------------------------------------|--------------------------------------------------------------|-------------|-----------|---------------|-------|-----------|--------------|----------|
|            |                                                  |                                                              | Min         | Typ       | Max           | Min   | Typ       | Max          |          |
| $V_{OS}$   | Input offset voltage <sup>4</sup>                | $T_J = 25^\circ C$<br>Full temperature range                 |             | 1         | 3<br>5        |       | 2         | 7<br>10      | mV       |
| $I_{BIAS}$ | Input bias current <sup>4</sup>                  | $T_J = 25^\circ C$<br>Full temperature range                 |             | 5         | 25<br>75      |       | 10        | 50<br>100    | nA       |
|            | Input impedance                                  | $T_J = 25^\circ C$                                           |             | $10^{10}$ |               |       | $10^{10}$ |              | $\Omega$ |
|            | Gain error                                       | $T_J = 25^\circ C$ , $R_L = 10k$<br>Full temperature range   |             | 0.002     | 0.005<br>0.02 |       | 0.004     | 0.01<br>0.02 | %        |
|            | Feedthrough attenuation ratio at 1kHz            | $T_J = 25^\circ C$ , $C_H = 0.01\mu F$                       | 86          | 96        |               | 80    | 90        |              | dB       |
|            | Output impedance                                 | $T_J = 25^\circ C$ , "HOLD" mode<br>Full temperature range   |             | 0.5       | 2<br>4        |       | 0.5       | 4<br>6       | $\Omega$ |
|            | "HOLD" step <sup>2</sup>                         | $T_J = 25^\circ C$ , $C_H = 0.01\mu F$ , $V_{OUT} = 0$       |             | 0.5       | 2.0           |       | 1.0       | 2.5          | mV       |
| $I_{CC}$   | Supply current <sup>4</sup>                      | $T_J \leq 25^\circ C$                                        |             | 4.5       | 5.5           |       | 4.5       | 6.5          | mA       |
|            | Logic and logic reference input current          | $T_J = 25^\circ C$                                           |             | 2         | 10            |       | 2         | 10           | $\mu A$  |
|            | Leakage current into hold capacitor <sup>4</sup> | $T_J = 25^\circ C$ , "HOLD" mode                             |             | 30        | 100           |       | 30        | 200          | pA       |
| $t_{AC}$   | Acquisition time to 0.1%                         | $\Delta V_{OUT} = 10V$ , $C_H = 1000pF$<br>$C_H = 0.01\mu F$ |             | 4<br>20   |               |       | 4<br>20   |              | $\mu s$  |
|            | Hold capacitor charging current                  | $V_{IN} - V_{OUT} = 2V$                                      |             | 5         |               |       | 5         |              | mA       |
|            | Supply voltage rejection ratio                   | $V_{OUT} = 0$                                                | 80          | 110       |               | 80    | 110       |              | dB       |
|            | Differential logic threshold                     | $T_J = 25^\circ C$                                           | 0.8         | 1.4       | 2.4           | 0.8   | 1.4       | 2.4          | V        |

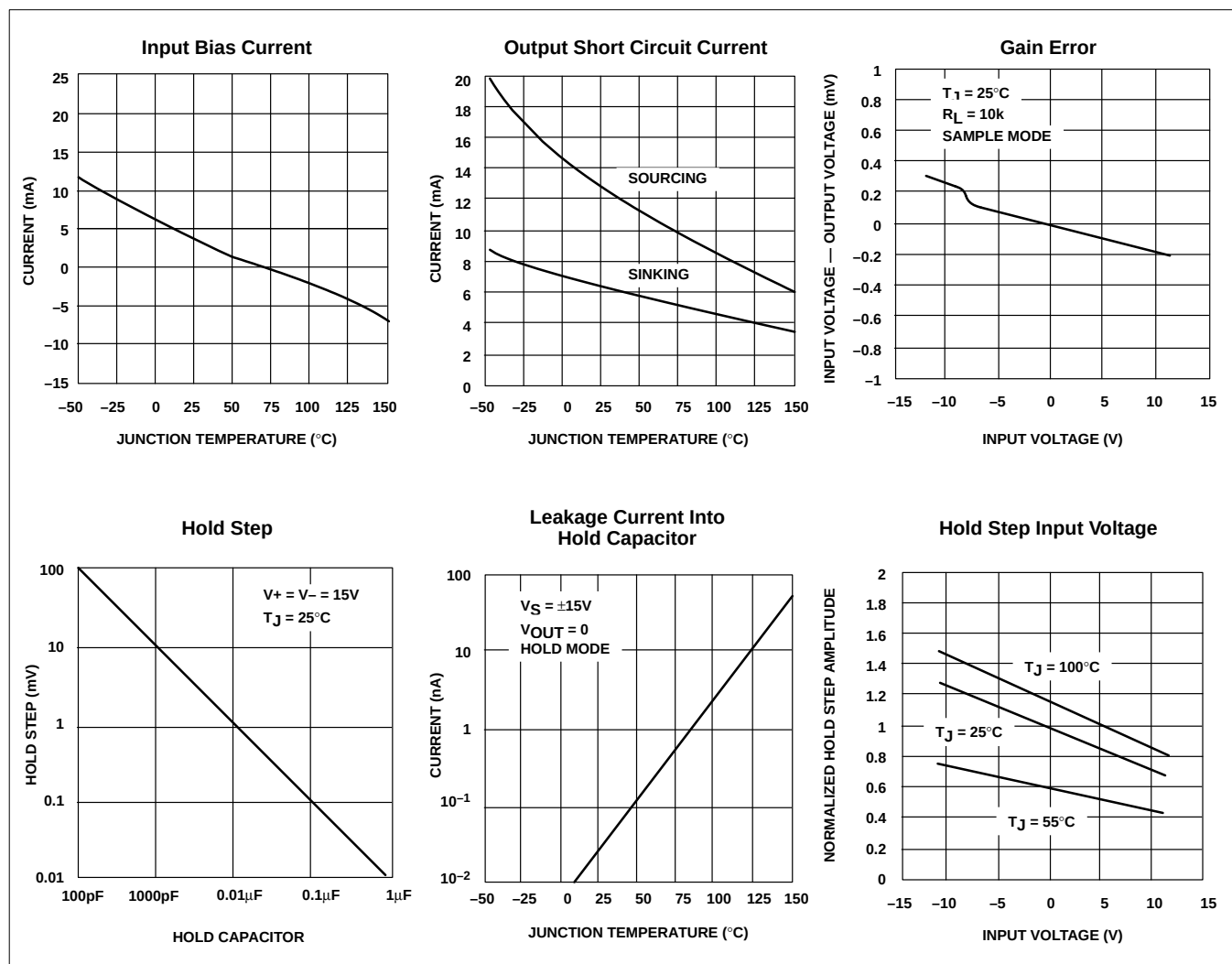
## NOTES:

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2. Hold step is sensitive to stray capacitive coupling between input logic signals and the hold capacitor. 1pF, for instance, will create an additional 0.5mV step with a 5V logic swing and a 0.01 $\mu F$  hold capacitor. Magnitude of the hold step is inversely proportional to hold capacitor value.
3. Leakage current is measured at a junction temperature of 25°C. The effects of junction temperature rise due to power dissipation or elevated ambient can be calculated by doubling the 25°C value for each 11°C increase in chip temperature. Leakage is guaranteed over full input signal range.
4. The parameters are guaranteed over a supply voltage of  $\pm 5$  to  $\pm 18V$ .

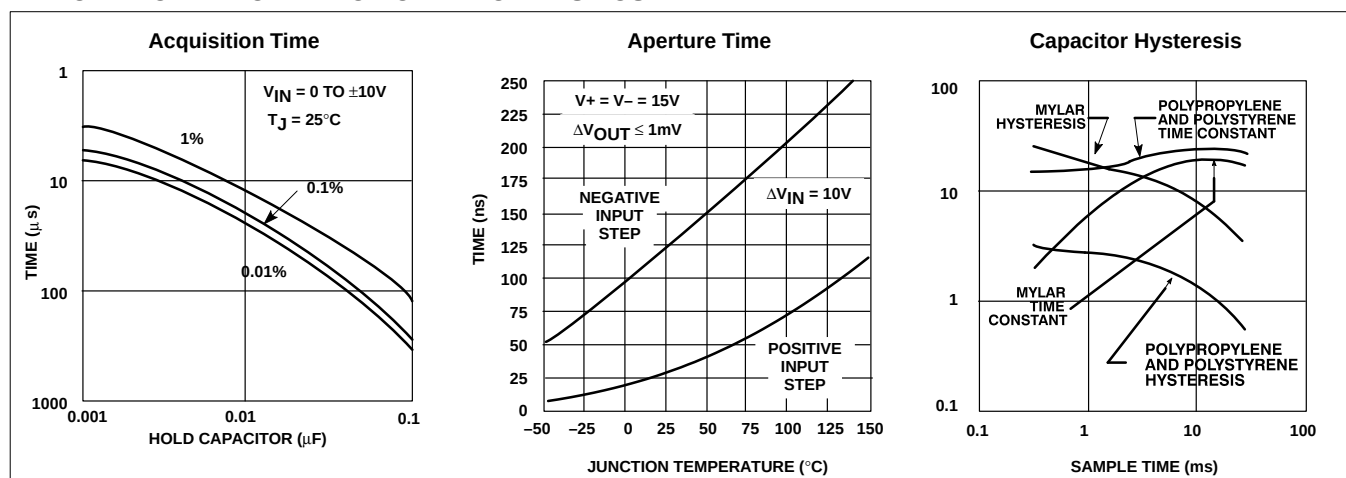
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## TYPICAL DC PERFORMANCE CHARACTERISTICS



## TYPICAL AC PERFORMANCE CHARACTERISTICS



## Sample-and-hold amplifiers

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## TYPICAL AC PERFORMANCE CHARACTERISTICS (Continued)

