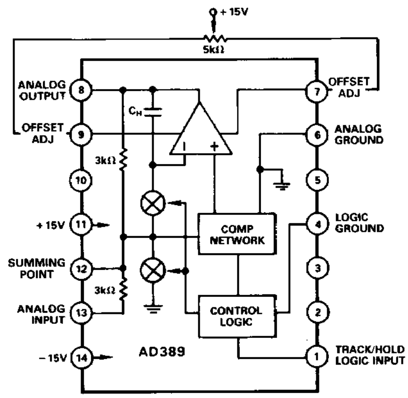
ANALOG DEVICES

High Resolution Track-and-Hold Amplifier

AD389

FEATURES
Companion to High Resolution A/D Converters
Fast Acquisition Time: 2.5μs to ±0.003%
Low Droop Rate: 0.1μV/μs
Aperture Jitter: 400ps
Internal Hold Capacitor
Unity Gain Inverter
Low Power Dissipation: 300mW

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD389 is a high accuracy, adjustment free track-and-hold amplifier designed for high resolution data acquisition applications. The fast acquisition time (2.5μs to ±0.003%) and low aperture jitter (400ps) make it suitable for use with fast A/D converters to digitize signals up to 40kHz.

The AD389 is complete with an internal hold capacitor and it incorporates a compensation network which minimizes the sample to hold charge offset.

Typical applications for the AD389 include sampled data systems, peak hold functions, strobed measurement systems and simultaneous sampling converter systems. When used with autozero and autocalibration techniques, this T/H combined with a high linearity A/D will offer 14-bit performance over the converter's full no-missing-code temperature range.

The device is available in two versions: the "K" specified for operation over the 0 to +70°C commercial temperature range and the "B" specified over the full industrial temperature range, −25°C to +85°C. High reliability processing is available; contact factory for information.

ORDERING GUIDE

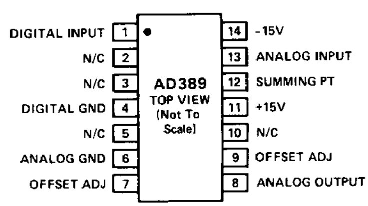
Model	Temperature Range	Package Option*
AD389KD	0 to +70°C	DH-14A
AD389BD	−25°C to +85°C	DH-14A

*DH-14A = Ceramic DIP. For outline information see Package Information section.

PRODUCT HIGHLIGHTS

1. The AD389 is the ideal companion track-and-hold amplifier to 14-bit accurate A/D converters.
2. The AD389 provides separate analog and digital grounds, thus improving the device's immunity to ground and switching transients.
3. The droop rate is only 0.1μV/μs so that it may be used in slower high resolution systems without the loss of accuracy.
4. The fast acquisition time and low aperture make it suitable for high speed data acquisition systems and digital audio recording.
5. The AD389 T/H amplifier is ideal for applications requiring wide dynamic range.
6. Clever circuit design eliminates any measurable thermal tail (see Figures 1a and 1b).

PIN CONFIGURATION



AD389—SPECIFICATIONS (typical @ +25°C and nominal power supply voltage of ±15 V unless otherwise noted)

Model	AD389KD	AD389BD	Units
ANALOG INPUT			
Voltage Range	±10 min	*	V
Overvoltage, no damage	±15 max	*	V
Impedance	3000	*	Ω
DIGITAL INPUT (TTL Compatible)			
Track Mode, Logic "1"	2 to 5.5V	*	V
Hold Mode, Logic "0"	0 to 0.8V	*	V
Logic "1" Current	20 (max)	*	μA
Logic "0" Current	−360 (max)	*	μA
ANALOG OUTPUT			
Voltage	±10 min	*	V
Current	3	*	mA
Short Circuit Current	20	*	mA
Impedance	1	*	Ω
DC ACCURACY/STABILITY			
Gain	−1.00	*	V/V
Gain Error	±0.01 (±0.02 max)	*	%
Gain Nonlinearity (±10V Output Track)	±0.001	*	%
Gain Temperature Coefficient	1 (5 max)	*	ppm/°C
Offset Voltage	±3 max, adjustable to zero	*	mV
Output Offset @ T_{min}, T_{max} (Track)	±6	*	mV
TRACK MODE DYNAMICS			
Frequency Response			
Small Signal (−3dB)	1.5	*	MHz
Full Power Bandwidth	0.5	*	MHz
Slew Rate	30	*	V/μs
Noise in Track Mode, dc to 1.0MHz	200	*	μV rms
TRACK-TO-HOLD SWITCHING			
Aperture Time	30	*	ns
Aperture Uncertainty (Jitter)	0.4	*	ns
Offset Step (Pedestal)	±2 (4 max)	*	mV
Pedestal with Temperature	±4	±6	mV
Switching Transient			
Amplitude	200	*	mV
Settling to 1mV	0.5 (2 max)	*	μs
Settling to 0.3mV	1.0 (3 max)	*	μs
HOLD MODE DYNAMICS			
Droop Rate	0.1 (1 max)	*	μV/μs
Droop Rate at T_{max}	10 max	40 max	μV/μs
Feedthrough Rejection (10V p-p @ 20kHz)	86 (74 min)	*	dB
HOLD-TO-TRACK DYNAMICS			
Acquisition Time to ±0.01% of 20V	1.5 (3 max)	*	μs
Acquisition Time to ±0.003% of 20V	2.5 (5 max)	*	μs
POWER REQUIREMENTS			
Nominal Voltages for Rated Performance	±15 (±3%)	*	V
Operating Range[1]	±11 to ±18	*	V
Power Supply Rejection	100	*	μV/V
Supply Current			
$+V_S$	15 (20 max)	*	mA
$-V_S$	−4 (10 max)	*	mA
Power Dissipation	300 (500 max)	*	mW
TEMPERATURE RANGE			
Operating	0 to +70	−25 to +85	°C
Storage	−55 to +125	*	°C
THERMAL RESISTANCE			
Junction to Air, θ_{JA} (free air)	60	*	°C/W
Junction to Case, θ_{JC}	20	*	°C/W

NOTES
[1]Operating to derated performance with $|V_{IN}| < |V_S - 5V|$.
*Specifications same as AD389KD.
Specifications subject to change without notice.

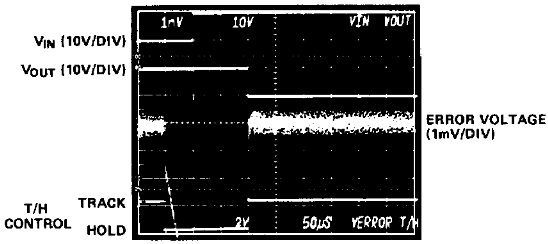


Figure 1a. Acquisition Time after 100µs in the Hold Mode. The AD389 shows No "Thermal Tail."

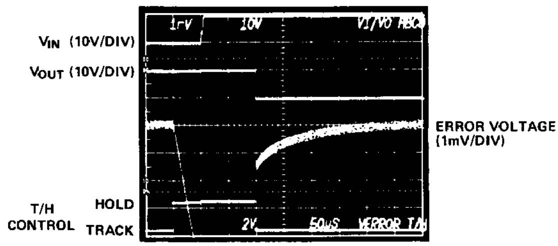


Figure 1b. Typical Thermal Tail and Acquisition Time of Other 12-Bit T/Hs Make Them Unsuitable for High Resolution Applications

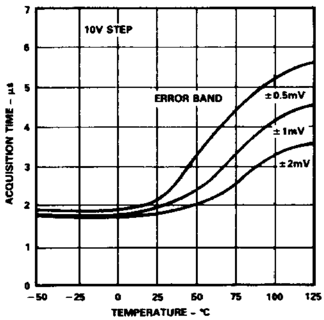


Figure 2. Acquisition Time vs. Temperature

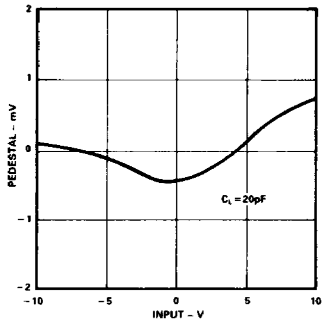


Figure 3. Pedestal vs. Input Voltage

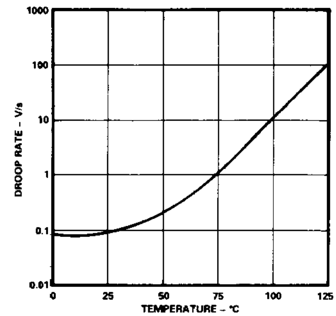


Figure 4. Droop Rate vs. Temperature

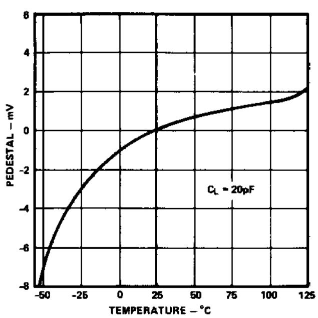


Figure 5. Pedestal vs. Temperature

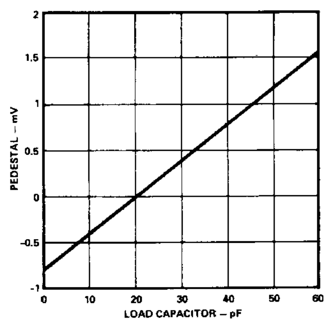


Figure 6. Pedestal vs. Load Capacitor

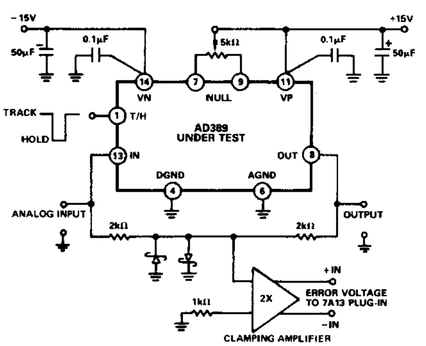


Figure 7. Pedestal and Acquisition Time Test Circuit

OFFSET ADJUST TRIM

In most data acquisition systems only one offset adjustment is made. In many cases it is the offset adjust of the ADC that is used to cancel all other accumulated system offsets. The offset or pedestal of the AD389 can be nulled by means of 5kΩ potentiometer between pins 7, 9, and 11. If the offset of the AD389 is not adjusted, then connect pins 7 and 9 to pin 14, the negative supply. Otherwise the high impedance of the null pin together with parasitic capacitances can cause tail effects.

GROUNDING

Many data-acquisition components have two or more ground pins which are not connected together within the device. These "grounds" are usually referred to as the Logic Power Return, Analog Common (Analog Power Return), and Analog Signal Ground. These grounds must be tied together at one point, preferably as close to the A-to-D converter as possible. Ideally, a single solid ground would be desirable. However, since current flows through the ground wires and etch stripes of the circuit cards, and since these paths have resistance and inductance, hundreds of millivolts can be generated between the system ground point and the ground pins of the AD389. Separate ground returns should be provided to minimize the current flow in the path from sensitive points to the system ground point. In this way supply currents and logic-gate return currents are not summed into the same return path as analog signals where they would cause measurement errors.

DECOUPLING

The AD389 can only settle accurately and fast if the power supplies do not change during transients. Therefore, it is necessary to put 0.1µF decoupling capacitors right between the supply and analog ground pins and to have 10µF tantalum caps close by.

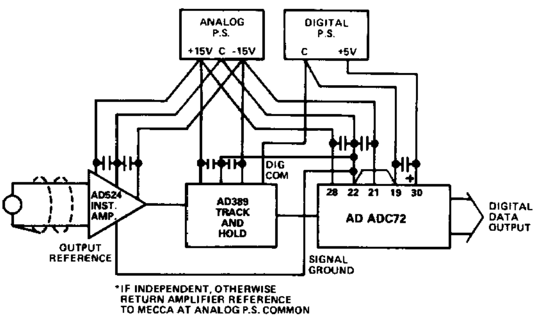


Figure 8. Basic Grounding and Decoupling Practice

SAMPLED DATA SYSTEMS

The fast acquisition time of the AD389 when used with a high speed A/D converter allows accurate digitization of high frequency signals and high throughput rates in multichannel data acquisition systems. Figure 9 shows the use of an AD389 with the AD376.

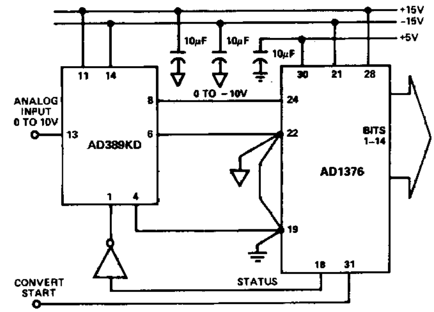


Figure 9. 20kHz-14-Bit, A/D Conversion System

CLEANLINESS, LEAKAGE AND DROOP

Track-and-hold amplifiers usually have one or more internal nodes which operate with extremely high impedances in the hold mode. Parasitic leakage at these nodes can degrade the part's droop rate, and ac signals coupled in through parasitic capacitance can introduce noise onto the held output. One such dc leakage path can be produced by the residual oils left on the package after it has been handled with bare fingers. Most normal board cleaning and flux removal procedures will remove these contaminants. For best results finger cots should be used when handling the AD389.