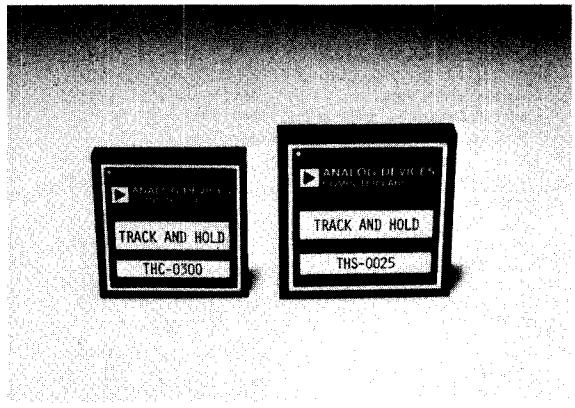
ANALOG DEVICES

Ultra High Speed Sample/Track-and-Hold Amplifiers

THS, THC SERIES

FEATURES
20ps Aperture Uncertainty (THS)
25 or 100ns Acquisition Times
0.01% Linearity
DC Coupled High Input Z Buffer

APPLICATIONS
Data Acquisition Systems
Peak Measurement Systems
Simultaneous Sample & Hold
Analog Delay & Storage



GENERAL DESCRIPTION

The THC-0300 and THS-0025 Sample/Track-and-Hold Amplifiers offer designers a choice of modules which can best meet the needs for various kinds of applications.

The THS-0025 has an acquisition time of 25ns and is capable of sample rates of 30MHz or higher for use in systems requiring this type of performance. The THC-0300 is not as fast as its companion T/H, but offers low droop rates, high output drive, and low feedthrough for situations which need those parameters. The combination of the two devices allows the system designer to make economical tradeoffs in choosing the precise characteristics needed for his design.

Both units feature high input impedance buffer amplifiers. The HTS-0025 is an "open-loop" T/H and achieves its speed with a dc-coupled Schottky diode sampling bridge; the "closed loop" HTC-0300 uses MOS FET switches.

APPLICATIONS

The most common use for a track and hold is to place it ahead of an A/D converter to allow the digitizing of signals with bandwidths higher than the digitizer alone can handle. The use of the THS-0025 can allow a reduction of system aperture to 20ps while THC-0300 units provide 100ps. These track and holds may also be used for peak holding functions, simultaneous sampling A/D's (with appropriate analog multiplexing), and other high speed analog signal processing applications. These modules have been used to construct 13-bit A/D converters with word rates as high as 10MHz. The THS/THC series is designed to operate in either the track-and-hold or sample-and-hold modes. They perform well with the MAS series' A/D converters.

TRACK-AND-HOLD (T/H) MODE

When a THS/THC unit is operated in the T/H mode, it is allowed to "track" the input signal for a period of time prior to initiating a "hold command". During the track period, the output follows the input, and the device functions as an amplifier. In the THC-0300, a resistor-gain-programmable op amp provides this function.

When a Logic "1" is input to the "hold command" input of the T/H, its output is frozen. This output level is held until the track mode is reestablished by a Logic "0" at the "hold command" input. This operation is shown graphically in Figure 1. The held output level is the voltage value at the input at the instant the hold command is applied, plus the aperture time.

Variations in the instants of sampling are called aperture uncertainty. It appears as jitter in the sampling point and can cause significant errors when very high dV/dt inputs are sampled.

During the hold period, feedthrough and droop rate can introduce errors at the output. It is important that a track and hold have high feedthrough rejection to prevent input to output leakage during the hold period. The droop rate is the amount the output changes during the hold period, as a result of loading on the internal hold capacitor.

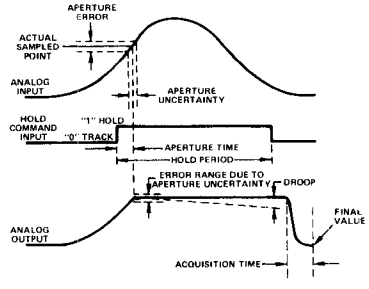


Figure 1. Track-and-Hold Operation

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SPECIFICATIONS (typical at 25°C and nominal supply voltages)

MODEL	UNITS	FAST THC-0300	ULTRA FAST THS-0025
DYNAMIC CHARACTERISTICS			
Acquisition Time (to 0.1%)	ns	100	25
Sample Rate (max)[1]	MHz	5	30
Aperture Time TTL	ns	18	10
ECL	ns	8	6
Settling Time THC to 0.1%, THS to 1% (See Figure 2)	ns	80	15
Bandwidth (Small Signal 3dB)	MHz	12	60
Slew Rate	V/μs	300	300
Aperture Uncertainty	ps max	100	20
Harmonic Distortion, 500kHz THC, 5MHz THS	dB	68	*
Feedthrough Rejection (dc to max Sample Rate/2) (dc to 5MHz THS)	dB	63	65
Droop Rate	μV/μs	12	5000
ACCURACY/STABILITY DC			
Gain	V/V	−1 ±2% (Pin 6 to Pin 15)	0.975
Gain vs. Temperature	ppm/°C	10	5
Zero Offset Voltage		Adjustable to Zero	*
Offset vs. Temperature	ppm/°C	10	30
Linearity	%	±0.01	*
INPUT			
Voltage	V max	±10	±2
Impedance	Ω	10^{10}	1M
Bias Current	nA	0.05	*
OUTPUT			
Voltage	V max	±10	±2 (No Load)
Current	mA	±50	*
Impedance		Less than 0.01Ω @ dc	5Ω (Output 1, Pin 21) 75Ω (Output 2, Pin 22)
Noise (dc to 15MHz THS) (dc to 2.5MHz THC)	μV rms	100	200
HOLD COMMAND (DIGITAL INPUTS)			(TTL or ECL Offered as no cost Options)
TTL Single Line Input (2 Std. TTL Loads)			
"0" = Sample/Track		0 to +0.4V	*
"1" = Hold		+2.4 to +5V	*
ECL		Single Line Input[2]	Two Line Complementary[3]
"0" = Sample/Track	V	−1.7	*
"1" = Hold	V	−0.8	*
POWER REQUIREMENTS			
+15V ±5% (THC) +12V to +15V (THS)	mA max	90	100
−15V ±5% (THC) −12V to −15V (THS)	mA max	80	100
+5V ±5% (THS) TTL Option	mA max	N/A	20
−5.2V ±5% (THS)	mA max	N/A	80
−5.2V ±5% (THS) ECL Option	mA max	N/A	24
Power Supply Rejection Ratio ±15V	mV/V max	10	20
TEMPERATURE RANGE			
Operating	°C	0 to +70	*
Storage	°C	−55 to +125	*
PHYSICAL CHARACTERISTICS			
Case		diallyl phthalate per MIL-M-14 type SDG-F	*

NOTES

[1] Sample rates shown are a guide only and are based on system acquisition times—not logic speed. These rates can be exceeded with acquisition time trade-offs.

[2] These inputs are unterminated. An external pull down resistor should be used when driven by ECL 10k logic source.

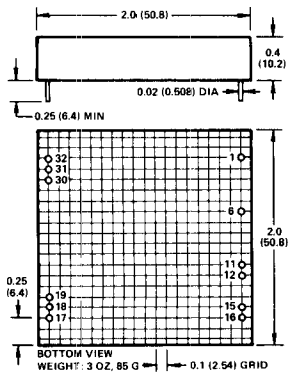
[3] These inputs are each terminated with a 330Ω pull down resistor to −5.2V.

*Specifications same as THC-0300.

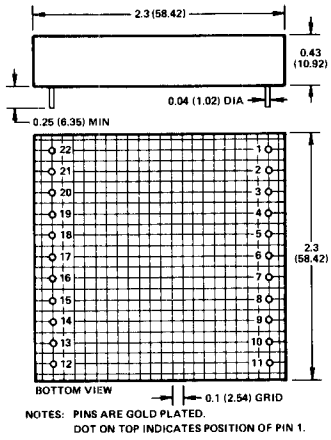
Specifications subject to change without notice.

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).



THC-0300



THS-0025

PIN DESIGNATIONS

PIN	THC-0300 FUNCTION	THS-0025 FUNCTION
1	ANALOG INPUT	GROUND
4	N/A	+15V
5	N/A	GROUND
6	FEEDBACK	-15V
7	N/A	HOLD COMMAND (ECL)
8	N/A	HOLD COMMAND (ECL)
9	N/A	HOLD COMMAND (TTL)
10	N/A	-5.2V
11	OFFSET ADJUST	+5V
12	OFFSET ADJUST	GROUND
13	N/A	OFFSET ADJUST
14	N/A	ANALOG INPUT 1
15	UNITY GAIN	N/A
16	ANALOG OUTPUT	GROUND
17	GROUND	N/A
18	-15V	N/A
19	+15V	N/A
20	N/A	GROUND
21	N/A	ANALOG OUTPUT 1
22	N/A	ANALOG OUTPUT 2
30	HOLD COMMAND (ECL)	N/A
31	HOLD COMMAND (TTL)	N/A
32	GROUND	N/A

When the hold command input returns to the track condition, the amount of time required for the T/H output to reestablish accurate tracking of the input signal is called the acquisition time. Figure 2 shows settling accuracy versus acquisition time. Figure 3 shows superimposed photographs of the input and output waveforms of a THS-0025 operated as a track-and-hold amplifier. Note that the output re-acquires the input just 12ns after the end of the hold time.

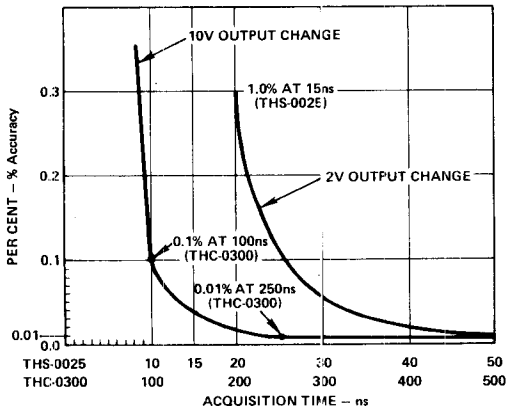


Figure 2. Acquisition Time vs. Settling Accuracy

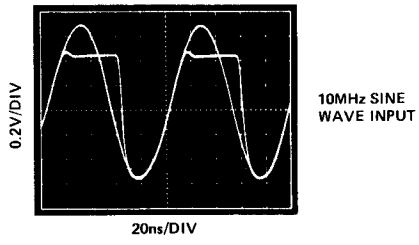


Figure 3. Track-and-Hold Operation (THS-0025)

SAMPLE AND HOLD (S/H) MODE

In the S/H mode of operation, devices are normally left in the hold condition. A very short sample pulse is applied to the hold command input when a new sample needs to be obtained at the output. The sample pulse width is dictated by the acquisition time. For small sample-to-sample variations, a pulse width as narrow as 12ns may be used for THS-0025 units and 80ns for THC-0300 units. For greater accuracy, sample pulses should be wider (see Figure 2).

In general, however, the pulse width to the THS-0025 should be 15ns to 50ns, depending on required accuracy. Figure 4 shows the input and output waveforms of a THS-0025 used in the S/H mode.

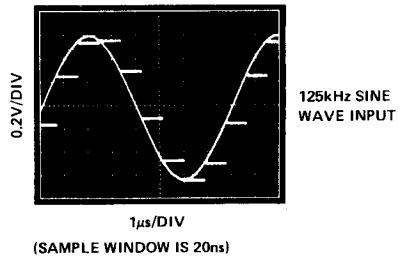


Figure 4. Sample-and-Hold Operation (THS-0025)

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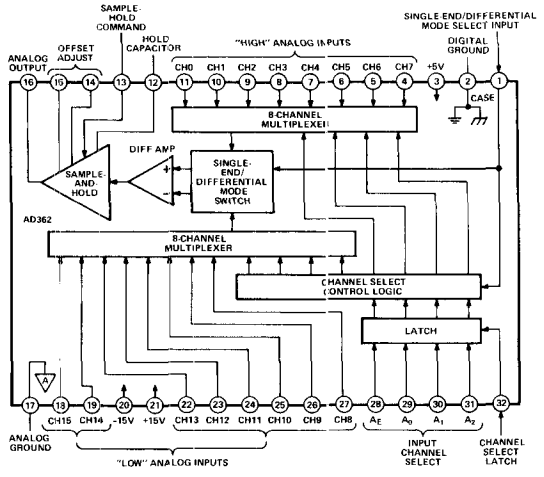
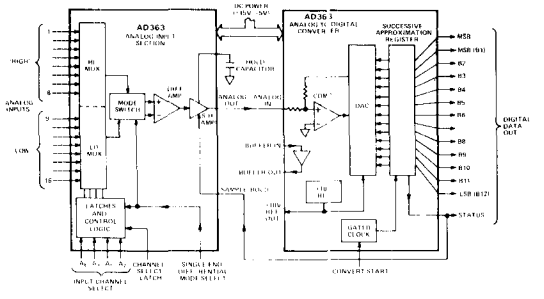
Selection Guide
Data Acquisition Subsystems



AD362

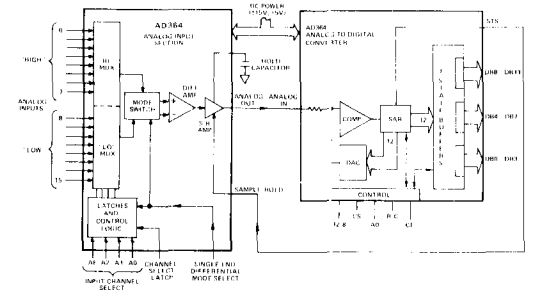
Page

- 16 Single-Ended or 8 Differential Channels with Switchable Mode Control — Vol. I 15-5
- True 12-Bit Precision: Nonlinearity ≤ ±0.005%
- High Speed: 10μs Acquisition Time to 0.01%
- Complete and Calibrated: No Additional Parts Required
- Small, Reliable: 32-Pin Hermetic Metal DIP
- Versatile: Simple Interface to Popular Analog-to-Digital Converters
- High Differential Input Impedance ($10^{10}\Omega$) and Common-Mode Rejection (80dB)
- Fully Protected Multiplexer Inputs



AD363

- Complete System in Reliable IC Form — Vol. I 15-13
- Small Size
- 16 Single-Ended or 8 Differential Channels with Switchable Mode Control
- Versatile Input/Output/Control Format
- Short-Cycle Capability
- True 12-Bit Operation: Nonlinearity ≤ ±0.012%
- Guaranteed No Missing Codes Over Temperature Range
- High Throughput Rate: 30kHz
- Low Power: 1.7W



AD364

- Complete Data Acquisition System in 2-Package IC Form — Vol. I 15-17
- Full 8- or 16-Bit Microprocessor Bus Interface
- 16 Single-Ended or 8 Differential Channels with Switchable Mode Control
- True 12-Bit Operation: Nonlinearity ≤ ±0.012%
- Guaranteed No Missing Codes Over Specified Temperature Range
- High Throughput Rate: 20kHz
- Fast Successive Approximation Conversion: 25μs
- Buried Zener Reference for Long-Term Stability and Low Gain TC
- Small Size: Requires Only 2.8 Square Inches
- Short Cycle Capability
- Low Power: 1.4W