

July 1994

High Speed Precision Sample and Hold Amplifier

Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- Gain, DC 2×10^6 V/V (Typ)
- Acquisition Time $1.0\mu\text{s}$ (0.01%) (Typ)
- Droop Rate $0.08\mu\text{V}/\mu\text{s}$ (+25°C) (Typ)
 $17\mu\text{V}/\mu\text{s}$ (Full Temperature) (Typ)
- Aperture Time 25ns (Typ)
- Hold Step Error 1.0mV (Typ)
- Internal Hold Capacitor
- Fully Differential Input
- TTL Compatible

Applications

- High Bandwidth Precision Data Acquisition Systems
- Inertial Navigation and Guidance Systems
- Ultrasonics
- SONAR / RADAR
- Digital to Analog Converter Deglitcher

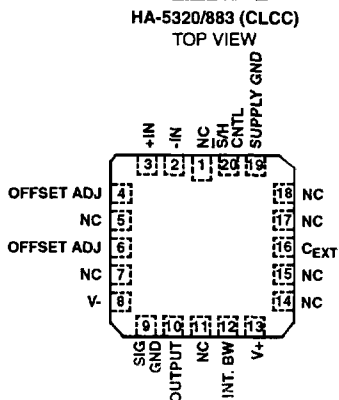
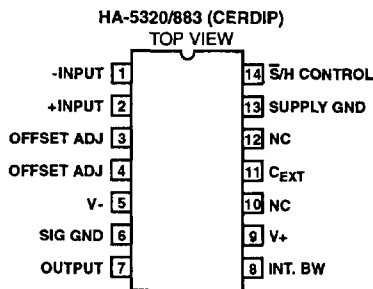
Description

The HA-5320/883 was designed for use in precision, high speed data acquisition systems.

The circuit consists of an input transconductance amplifier capable of providing large amounts of charging current, a low leakage analog switch, and an output integrating amplifier. The analog switch sees virtual ground as its load; therefore, charge injection on the hold capacitor is constant over the entire input/output voltage range. The pedestal voltage resulting from this charge injection can be adjusted to zero by use of the offset adjust inputs. The device includes a hold capacitor. However, if improved droop rate is required at the expense of acquisition time, additional hold capacitance may be added externally.

This monolithic device is manufactured using the Harris Dielectric Isolation Process, minimizing stray capacitance and eliminating SCR's. This allows higher speed and latch-free operation. For further information, please see Application Note AN538.

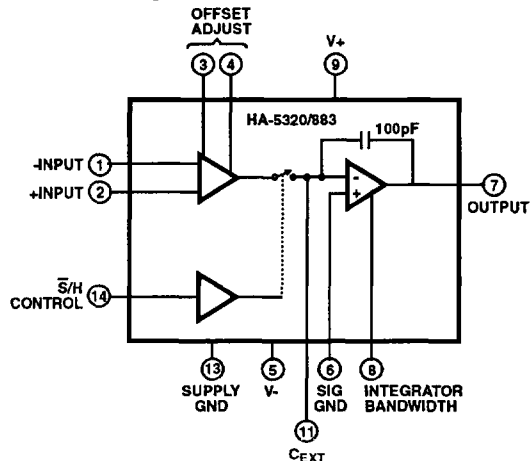
Pinouts



Ordering Information

| PART NUMBER | TEMPERATURE RANGE | PACKAGE |
|--------------|-------------------|---------------------|
| HA1-5320/883 | -55°C to +125°C | 14 Lead CerDIP |
| HA4-5320/883 | -55°C to +125°C | 20 Lead Ceramic LCC |

Functional Diagram



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Specifications HA-5320/883

Absolute Maximum Ratings

| | |
|-------------------------------------|-----------------|
| Voltage Between V+ and V- Terminals | 40V |
| Differential Input Voltage | 24V |
| Digital Input Voltage (S/H Pin) | +8V, -15V |
| Output Current, Continuous (Note 1) | ±20mA |
| Storage Temperature Range | -65°C to +150°C |
| Junction Temperature | +175°C |
| Lead Temperature (Soldering 10s) | +300°C |
| ESD Classification | <2000V |

Thermal Information

| | | |
|---|---------------|---------------|
| Thermal Resistance | θ_{JA} | θ_{JC} |
| CerDIP Package | 66°C/W | 16°C/W |
| Ceramic LCC Package | 57°C/W | 9°C/W |
| Package Power Dissipation at +75°C | | |
| CerDip Package | 1.5W | |
| Ceramic LCC Package | 1.75W | |
| Package Power Dissipation Derating Factor Above +75°C | | |
| CerDip Package | 15mW/°C | |
| Ceramic LCC Package | 17mW/°C | |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Operating Conditions

| | | | |
|---|---------------------------------|-------------------------------------|--------------|
| Operating Temperature Range | -55°C ≤ T _A ≤ +125°C | Logic Level Low (V _{IL}) | 0.0V to 0.8V |
| Operating Supply Voltage (±V _S) | ±15V | Logic Level High (V _{IH}) | 2.0V to 5.0V |
| Analog Input Voltage | ±10V | | |

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

Device Tested at: V+ = +15V; V- = -15V; V_{IL} = 0.8V (Sample); V_{IH} = 2.0V (Hold); C_H = Internal = 100pF; Signal GND = Supply GND, Unless Otherwise Specified

| PARAMETERS | SYMBOL | CONDITIONS | GROUP A SUBGROUP | TEMPERATURE | LIMITS | | UNITS | |
|-----------------------------|------------------|--|---|---------------|---------------|------|-------|----|
| | | | | | MIN | MAX | | |
| Input Offset Voltage | V _{IO} | | 1 | +25°C | -1 | +1 | mV | |
| | | | 2, 3 | +125°C, -55°C | -2 | +2 | mV | |
| Input Bias Current | +I _B | | 1 | +25°C | -200 | +200 | nA | |
| | | | 2, 3 | +125°C, -55°C | -200 | +200 | nA | |
| | -I _B | | 1 | +25°C | -200 | +200 | nA | |
| | | | 2, 3 | +125°C, -55°C | -200 | +200 | nA | |
| Input Offset Current | I _{IO} | | 1 | +25°C | -100 | +100 | nA | |
| | | | 2, 3 | +125°C, -55°C | -100 | +100 | nA | |
| Open Loop Voltage Gain | +A _{VS} | R _L = 1kΩ, V _{OUT} = +10V | 1 | +25°C | 120 | - | dB | |
| | | | 2, 3 | +125°C, -55°C | 110 | - | dB | |
| | -A _{VS} | R _L = 1kΩ, V _{OUT} = -10V | 1 | +25°C | 120 | - | dB | |
| | | | 2, 3 | +125°C, -55°C | 110 | - | dB | |
| Common Mode Rejection Ratio | +CMRR | V+ = 10V, V- = -20V, V _{OUT} = -5V, V _{SH} = -4.2V, V _{GND} = -5V | 1 | +25°C | 80 | - | dB | |
| | | | 2, 3 | +125°C, -55°C | 80 | - | dB | |
| | -CMRR | | V+ = 20V, V- = -10V, V _{OUT} = +5V, V _{SH} = 5.8V, V _{GND} = +5V | 1 | +25°C | 80 | - | dB |
| | | | | 2, 3 | +125°C, -55°C | 80 | - | dB |
| Output Current | +I _O | V _{OUT} = +10V | 1 | +25°C | 10 | - | mA | |
| | | | 2, 3 | +125°C, -55°C | 10 | - | mA | |
| | -I _O | V _{OUT} = -10V | 1 | +25°C | -10 | - | mA | |
| | | | 2, 3 | +125°C, -55°C | -10 | - | mA | |

CAUTION: These devices are sensitive to electronic discharge. Proper IC handling procedures should be followed.

Spec Number **511096-883**

Specifications HA-5320/883

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

Device Tested at: $V_+ = +15V$; $V_- = -15V$; $V_{IL} = 0.8V$ (Sample); $V_{IH} = 2.0V$ (Hold); $C_H = \text{Internal} = 100pF$; Signal GND = Supply GND, Unless Otherwise Specified

| PARAMETERS | SYMBOL | CONDITIONS | GROUP A SUBGROUP | TEMPERATURE | LIMITS | | UNITS |
|------------------------------|------------------|---|---------------------|---------------|--------|-----|---------------|
| | | | | | MIN | MAX | |
| Output Voltage Swing | +V _{OP} | R _L = 1k Ω | 1 | +25°C | 10 | - | V |
| | | | 2, 3 | +125°C, -55°C | 10 | - | V |
| | -V _{OP} | R _L = 1k Ω | 1 | +25°C | - | -10 | V |
| | | | 2, 3 | +125°C, -55°C | - | -10 | V |
| Power Supply Current | +I _{CC} | V _{OUT} = 0V, I _{OUT} = 0mA | 1 | +25°C | - | 13 | mA |
| | | | 2, 3 | +125°C, -55°C | - | 13 | mA |
| | -I _{CC} | V _{OUT} = 0V, I _{OUT} = 0mA | 1 | +25°C | -13 | - | mA |
| | | | 2, 3 | +125°C, -55°C | -13 | - | mA |
| Power Supply Rejection Ratio | +PSRR | V ₊ = 14.5V, 15.5V V ₋ = -15V, -15V | 1 | +25°C | 80 | - | dB |
| | | | 2, 3 | +125°C, -55°C | 80 | - | dB |
| | -PSRR | V ₊ = +15V, +15V, V ₋ = -14.5V, -15.5V | 1 | +25°C | 65 | - | dB |
| | | | 2, 3 | +125°C, -55°C | 65 | - | dB |
| Digital Input Current | I _{INL} | V _{IN} = 0V | 1 | +25°C | - | 4 | μA |
| | | | 2, 3 | +125°C, -55°C | - | 10 | μA |
| | I _{INH} | V _{IN} = 5V | 1 | +25°C | - | 0.1 | μA |
| | | | 2, 3 | +125°C, -55°C | - | 0.1 | μA |
| Digital Input Voltage | V _{IL} | | 1 | +25°C | - | 0.8 | V |
| | | | 2, 3 | +125°C, -55°C | - | 0.8 | V |
| | V _{IH} | | 1 | +25°C | 2.0 | - | V |
| | | | 2, 3 | +125°C, -55°C | 2.0 | - | V |
| Output Voltage Droop Rate | V _D | V _{OUT} = 0V | 2 | +125°C | - | 100 | $\mu V/\mu s$ |

NOTE:

1. Internal power dissipation may limit output current below 20mA.

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

Table 2 Intentionally Left Blank. See AC Specifications in Table 3.

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SAMPLE AND HOLD AMPLIFIERS

Specifications HA-5320/883

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

| PARAMETER | SYMBOL | CONDITIONS | NOTES | TEMPERATURE | LIMITS | | UNITS |
|---------------------------|-----------------|---|-------|-------------|--------|-----|---------------|
| | | | | | MIN | MAX | |
| Hold Mode Feedthrough | V_{HMF} | $V_{IN} = 10V_{P-P}$, 100kHz | 1 | +25°C | - | 3 | mV |
| Hold Step Error | V_{ERROR} | $V_{IH} = 3.5V$, $V_{IL} = 0V$, $T_{RISE} (V_{IL} \text{ to } V_{IH}) = 10ns$ | 1 | +25°C | -11 | 11 | mV |
| Sample Mode Noise Voltage | $E_{N(SAMPLE)}$ | DC to 10MHz, $V_{SH} = 0V$, $R_{LOAD} = 2k\Omega$ | 1 | +25°C | - | 200 | μV_{RMS} |
| Hold Mode Noise Voltage | $E_{N(HOLD)}$ | DC to 10MHz, $V_{SH} = 5V$, $R_{LOAD} = 2k\Omega$ | 1 | +25°C | - | 200 | μV_{RMS} |
| Input Capacitance | C_{IN} | $V_{SH} = 0V$ | 1 | +25°C | - | 5 | pF |
| Input Resistance | R_{IN} | $V_{SH} = 0V$, Delta $V_{IN} = 20V$ | 1 | +25°C | 1 | - | M Ω |
| Slew Rate | +SR | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = -5V \text{ to } +5V \text{ Step}$ 10%, 90% pts | 1 | +25°C | 30 | - | V/ μs |
| | -SR | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = +5V \text{ to } -5V \text{ Step}$ 10%, 90% pts | 1 | +25°C | 30 | - | V/ μs |
| Rise and Fall Times | T_R | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = 0V \text{ to } +200mV \text{ Step}$ 10%, 90% pts | 1 | +25°C | - | 150 | ns |
| | T_F | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = 0V \text{ to } -200mV \text{ Step}$ 10%, 90% pts | 1 | +25°C | - | 150 | ns |
| Overshoot | +OS | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = 0V \text{ to } +200mV \text{ Step}$ | 1 | +25°C | - | 25 | % |
| | -OS | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = 0V \text{ to } -200mV \text{ Step}$ | 1 | +25°C | - | 25 | % |
| 0.1% Acquisition Time | $T_{ACQ} 0.1\%$ | $C_L = 50pF$, $R_L = 2k\Omega$, $V_{OUT} = 0V \text{ to } 10V \text{ Step}$ | 1 | +25°C | - | 1.2 | μs |

NOTE:

- The parameters listed in this table are controlled via design or process parameters and are not directly tested. These parameters are characterized upon initial design release and upon design changes which would affect these characteristics.

TABLE 4. ELECTRICAL TEST REQUIREMENTS

| MIL-STD-883 TEST REQUIREMENTS | SUBGROUPS (SEE TABLE 1) |
|---|-------------------------|
| Interim Electrical Parameters (Pre Burn-In) | - |
| Final Electrical Test Parameters | 1(Note 1), 2, 3 |
| Group A Test Requirements | 1, 2, 3 |
| Groups C and D Endpoints | 1 |

NOTE:

- PDA applies to Subgroup 1 only. No other subgroups are included in PDA.

Die Characteristics

DIE DIMENSIONS:

92 x 152 x 19 ± 1mils

METALLIZATION:

Type: Al, 1% Cu
 Thickness: 16kÅ ± 2kÅ

GLASSIVATION:

Type: Nitride (Si₃N₄) over Silox (SiO₂, 5% Phos)
 Silox Thickness: 12kÅ ± 2kÅ
 Nitride Thickness: 3.5kÅ ± 1.5kÅ

WORST CASE CURRENT DENSITY:

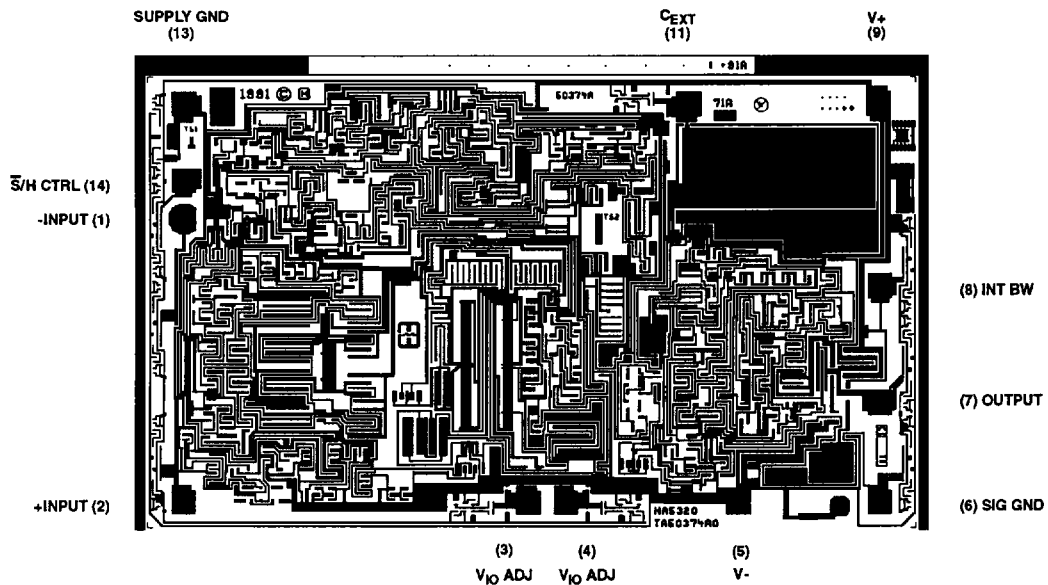
1.742 x 10⁵ A/cm²

TRANSISTOR COUNT: 184

SUBSTRATE POTENTIAL: V-

Metallization Mask Layout

HA-5320/883



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