

May 1997

## 8-Bit, 20 MSPS Flash A/D Converter

### Features

- This Circuit is Processed in Accordance to MIL-STD-883 and is Fully Conformant Under the Provisions of Paragraph 1.2.1.
- 20 MSPS with No Missing Codes
- 18MHz Full Power Input Bandwidth
- No Missing Codes Over Temperature
- Sample and Hold Not Required
- Single +5V Supply Voltage
- CMOS/TTL
- Overflow Bit

### Applications

- Video Digitizing
- Radar Systems
- Medical Imaging
- Communication Systems
- High Speed Data Acquisition Systems

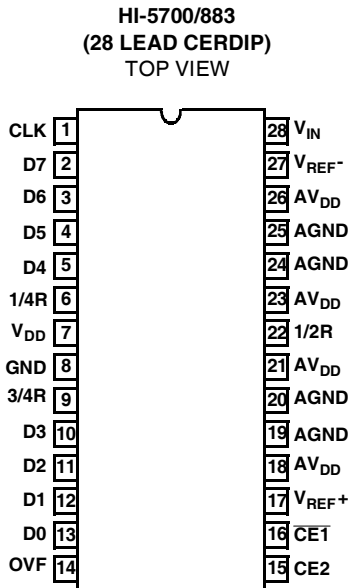
### Description

The HI-5700/883 is a monolithic, 8-bit, CMOS Flash Analog-to-Digital Converter. It is designed for high speed applications where wide bandwidth and low power consumption are essential. Its 20 MSPS speed is made possible by a parallel architecture which also eliminates the need for an external sample and hold circuit. The HI-5700/883 delivers  $\pm 0.5$  LSB differential nonlinearity while consuming only 725mW (typical) at 20 MSPS. Microprocessor compatible data output latches are provided which present valid data to the output bus 1.5 clock cycles after the convert command is received. An overflow bit is provided to allow the series connection of two converters to achieve 9-bit resolution.

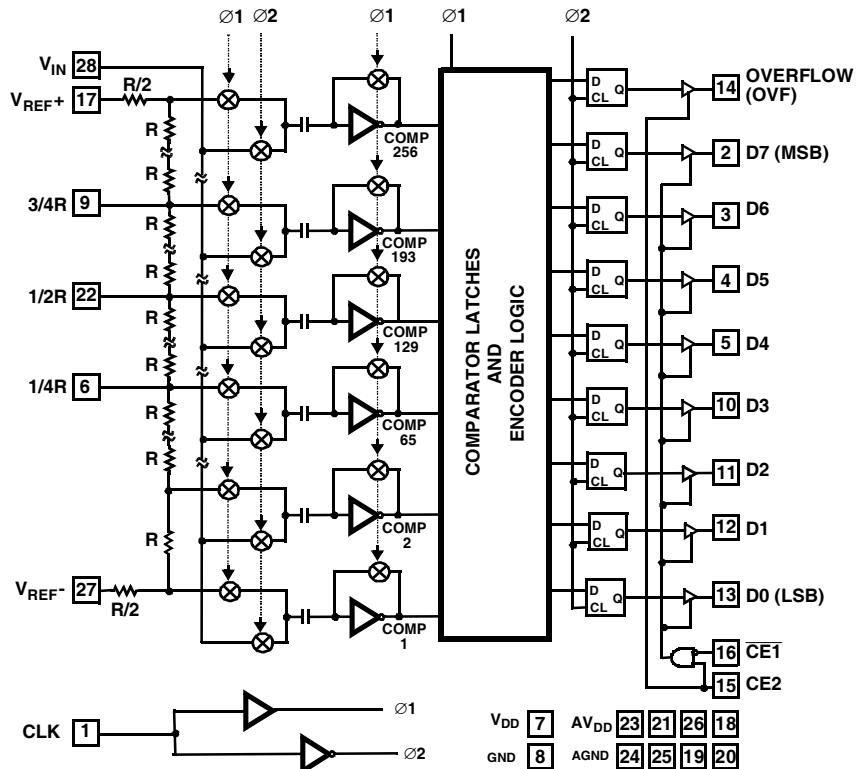
### Ordering Information

PART NUMBER	TEMPERATURE RANGE	PACKAGE
HI1-5700S/883	-55°C to +125°C	28 Lead CerDIP

### Pinout



### Functional Block Diagram



**Pin Descriptions**

PIN #	NAME	DESCRIPTION
1	CLK	Clock Input
2	D7	Bit 7, Output (MSB)
3	D6	Bit 6, Output
4	D5	Bit 5, Output
5	D4	Bit 4, Output
6	1/4R	1/4th Point of Reference Ladder
7	V <sub>DD</sub>	Digital Power Supply
8	GND	Digital Ground
9	3/4R	3/4th Point of Reference Ladder
10	D3	Bit 3, Output
11	D2	Bit 2, Output
12	D1	Bit 1, Output
13	D0	Bit 0, Output (LSB)
14	OVF	Overflow, Output
15	CE2	Three-State Output Enable Input, Active High. (See Truth Table)
16	CE1	Three-State Output Enable Input, Active Low. (See Truth Table)
17	V <sub>REF+</sub>	Reference Voltage Positive Input
18	AV <sub>DD</sub>	Analog Power Supply, +5V
19	AGND	Analog Ground
20	AGND	Analog Ground
21	AV <sub>DD</sub>	Analog Power Supply, +5V
22	1/2R	1/2 Point of Reference Ladder
23	AV <sub>DD</sub>	Analog Power Supply, +5V
24	AGND	Analog Ground
25	AGND	Analog Ground
26	AV <sub>DD</sub>	Analog Power Supply, +5V
27	V <sub>REF-</sub>	Reference Voltage Negative Input
28	V <sub>IN</sub>	Analog Input

**Chip Enable Truth Table**

CE1	CE2	D0 - D7	OVF
0	1	Valid	Valid
1	1	Three-State	Valid
X	0	Three-State	Three-State

X = Don't Care.

## Specifications HI-5700/883

### Absolute Maximum Ratings

Supply Voltage, $V_{DD}$ to GND . . . . .	$(GND - 0.5) < V_{DD} < +7.0V$
Analog and Reference Input Pins. . . . .	$(V_{SS} - 0.5) < V_{INA} < (V_{DD} + 0.5V)$
Digital I/O Pins . . . . .	$(GND - 0.5) < V_{I/O} < (V_{DD} + 0.5V)$
Operating Temperature Range	
HI1-5700S/883 . . . . .	-55°C to +125°C
Junction Temperature. . . . .	+175°C
Storage Temperature Range . . . . .	-65°C to +150°C
Lead Temperature (Soldering, 10s) . . . . .	300°C
ESD Classification . . . . .	Class 1

### Thermal Information

Thermal Resistance	$\theta_{JA}$	$\theta_{JC}$
HI1-5700S/883 . . . . .	47°C/W	28°C/W
Power Dissipation at +75°C (Note 1)		
HI1-5700S/883 . . . . .		2100mW
Power Dissipation Derating Factor Above +75°C		
HI1-5700S/883 . . . . .		21mW/°C
Reliability Information		
Transistor Count . . . . .		14677
Worst Case Density . . . . .		$3.05 \times 10^4 A/cm^2$

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.

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at:  $AV_{DD} = V_{DD} = +5.0V$ ;  $V_{REF+} = +4.0V$ ;  $V_{REF-} = GND = AGND = 0V$ ;  $F_S =$  Specified Clock Frequency at 50% Duty Cycle;  $C_L = 30pF$ ; Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNIT
					MIN	MAX	
<b>ACCURACY</b>							
Integral Linearity Error (Best Fit Method)	INL	$F_S = 15MHz, f_{IN} = DC$	1	+25°C	-	±2.0	LSB
			2, 3	+125°C, -55°C	-	±2.65	LSB
		$F_S = 20MHz, f_{IN} = DC$	1	+25°C	-	±2.25	LSB
			2, 3	+125°C, -55°C	-	±4.1	LSB
Differential Linearity Error (Guaranteed No Missing Codes)	DNL	$F_S = 15MHz, f_{IN} = DC$	1	+25°C	-	±0.9	LSB
			2, 3	+125°C, -55°C	-	±1.0	LSB
		$F_S = 20MHz, f_{IN} = DC$	1	+25°C	-	±0.9	LSB
			2, 3	+125°C, -55°C	-	±1.0	LSB
Offset Error (Adjustable to Zero)	VOS	$F_S = 15MHz, f_{IN} = DC$	1	+25°C	-	±8.0	LSB
			2, 3	+125°C, -55°C	-	±9.5	LSB
		$F_S = 20MHz, f_{IN} = DC$	1	+25°C	-	±8.0	LSB
			2, 3	+125°C, -55°C	-	±9.5	LSB
Full Scale Error (Adjustable to Zero)	FSE	$F_S = 15MHz, f_{IN} = DC$	1	+25°C	-	±4.5	LSB
			2, 3	+125°C, -55°C	-	±8.0	LSB
		$F_S = 20MHz, f_{IN} = DC$	1	+25°C	-	±4.5	LSB
			2, 3	+125°C, -55°C	-	±8.0	LSB
<b>ANALOG INPUT</b>							
Analog Input Resistance	$R_{IN}$	$V_{IN} = 4V$	1	+25°C	4	-	MΩ
			2, 3	+125°C, -55°C	4	-	MΩ
Analog Input Bias Current	$I_B$	$V_{IN} = 0V, 4V$	1	+25°C		±1.0	μA
			2, 3	+125°C, -55°C		±1.0	μA
<b>REFERENCE INPUT</b>							
Total Reference Resistance	$R_L$		1	+25°C	250	-	Ω
			2, 3	+125°C, -55°C	235	-	Ω

## Specifications HI-5700/883

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

Device Tested at:  $V_{DD} = V_{DD} = +5.0V$ ;  $V_{REF+} = +4.0V$ ;  $V_{REF-} = GND = AGND = 0V$ ;  $F_S =$  Specified Clock Frequency at 50% Duty Cycle;  $C_L = 30pF$ ; Unless Otherwise Specified.

PARAMETERS	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNIT
					MIN	MAX	
<b>DIGITAL INPUTS</b>							
Input High Voltage	$V_{IH}$		1	+25°C	2.0	-	V
			2, 3	+125°C, -55°C	2.0	-	V
Input Low Voltage	$V_{IL}$		1	+25°C	-	0.8	V
			2, 3	+125°C, -55°C	-	0.8	V
Logic Input Current	$I_{IN}$	$V_{IN} = 0V, +5V$	1	+25°C	-	$\pm 1$	$\mu A$
			2, 3	+125°C, -55°C	-	$\pm 1$	$\mu A$
<b>DIGITAL OUTPUTS</b>							
Output Leakage	$I_{OZ}$	$CE2 = 0V, V_O = 0V, 5V$	1	+25°C	-	$\pm 1.0$	$\mu A$
			2, 3	+125°C, -55°C	-	$\pm 1.0$	$\mu A$
Output Logic Source Current	$I_{OH}$	$V_O = 4.5V$	1	+25°C	-3.2	-	mA
			2, 3	+125°C, -55°C	-3.2	-	mA
Output Logic Sink Current	$I_{OL}$	$V_O = 0.4V$	1	+25°C	3.2	-	mA
			2, 3	+125°C, -55°C	3.2	-	mA
<b>POWER SUPPLY REJECTION</b>							
Offset Error PSRR	$\Delta VOS$	$V_{DD} = 5V \pm 10\%$	1	+25°C	-	$\pm 2.75$	LSB
			2, 3	+125°C, -55°C	-	$\pm 5.5$	LSB
Gain Error PSRR	$\Delta FSE$	$V_{DD} = 5V \pm 10\%$	1	+25°C	-	$\pm 2.75$	LSB
			2, 3	+125°C, -55°C	-	$\pm 5.5$	LSB
<b>POWER SUPPLY CURRENT</b>							
Supply Current	$I_{DD}$	$F_S = 20MHz$	1	+25°C	-	180	mA
			2, 3	+125°C, -55°C	-	190	mA

NOTE:

1. Dissipation rating assumes device is mounted with all leads soldered to printed circuit board.

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

Device Tested at:  $V_{DD} = V_{DD} = +5.0V$ ;  $V_{REF+} = +4.0V$ ;  $V_{REF-} = GND = AGND = 0V$ ;  $F_S =$  Specified Clock Frequency at 50% Duty Cycle;  $C_L = 30pF$ ; Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNIT
					MIN	MAX	
Maximum Conversion Rate		No Missing Codes	9	+25°C	20	-	MSPS
			10, 11	+125°C, -55°C	20	-	MSPS
Data Output Enable Time	$t_{EN}$		9	+25°C	-	25	ns
			10, 11	+125°C, -55°C	-	30	ns

## Specifications HI-5700/883

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

Device Tested at:  $A_{V_{DD}} = V_{DD} = +5.0V$ ;  $V_{REF+} = +4.0V$ ;  $V_{REF-} = GND = AGND = 0V$ ;  $F_S$  = Specified Clock Frequency at 50% Duty Cycle;  $C_L = 30pF$ ; Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	GROUP A SUBGROUP	TEMPERATURE	LIMITS		UNIT
					MIN	MAX	
Data Output Disable Time	$t_{DIS}$		9	+25°C	-	20	ns
			10, 11	+125°C, -55°C	-	25	ns
Data Output Delay	$t_{OD}$		9	+25°C	-	25	ns
			10, 11	+125°C, -55°C	-	30	ns
Data Output Hold	$t_H$		9	+25°C	10	-	ns
			10, 11	+125°C, -55°C	5	-	ns

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (NOTE 1)**

Device Characterized at:  $A_{V_{DD}} = V_{DD} = +5.0V$ ;  $V_{REF+} = +4.0V$ ;  $V_{REF-} = GND = AGND = 0V$ ;  $F_S$  = Specified Clock Frequency at 50% Duty Cycle;  $C_L = 30pF$ ; Unless Otherwise Specified.

PARAMETER	SYMBOL	CONDITIONS	TEMPERATURE	LIMITS		UNIT
				MIN	MAX	
Minimum Conversion Rate		No Missing Codes	+25°C, +125°C, -55°C	-	0.125	MSPS

**NOTE:**

- Parameters listed in Table 3 are controlled via design or process parameters and are not directly tested at final production. These parameters are lab characterized upon initial design release, or upon design changes. These parameters are guaranteed by characterization based upon data from multiple production runs which reflect lot to lot and within lot variation.

**TABLE 4. ELECTRICAL TEST REQUIREMENTS**

MIL-STD-883 TEST REQUIREMENTS	SUBGROUPS (SEE TABLES 1 AND 2)
Interim Electrical Parameters (Pre Burn-In)	1
Final Electrical Test Parameters	1 (Note 1), 2, 3, 9, 10, 11
Group A Test Requirements	1, 2, 3, 9, 10, 11
Groups C & D Endpoints	1

**NOTE:**

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

**Die Characteristics**

**DIE DIMENSIONS:**

154.3 x 173.2 x 19 ± 1mils

**METALLIZATION:**

Type: Si - Al  
 Thickness: 11kÅ ± 1kÅ

**GLASSIVATION:**

Type: SiO<sub>2</sub>  
 Thickness: 8kÅ ± 1kÅ

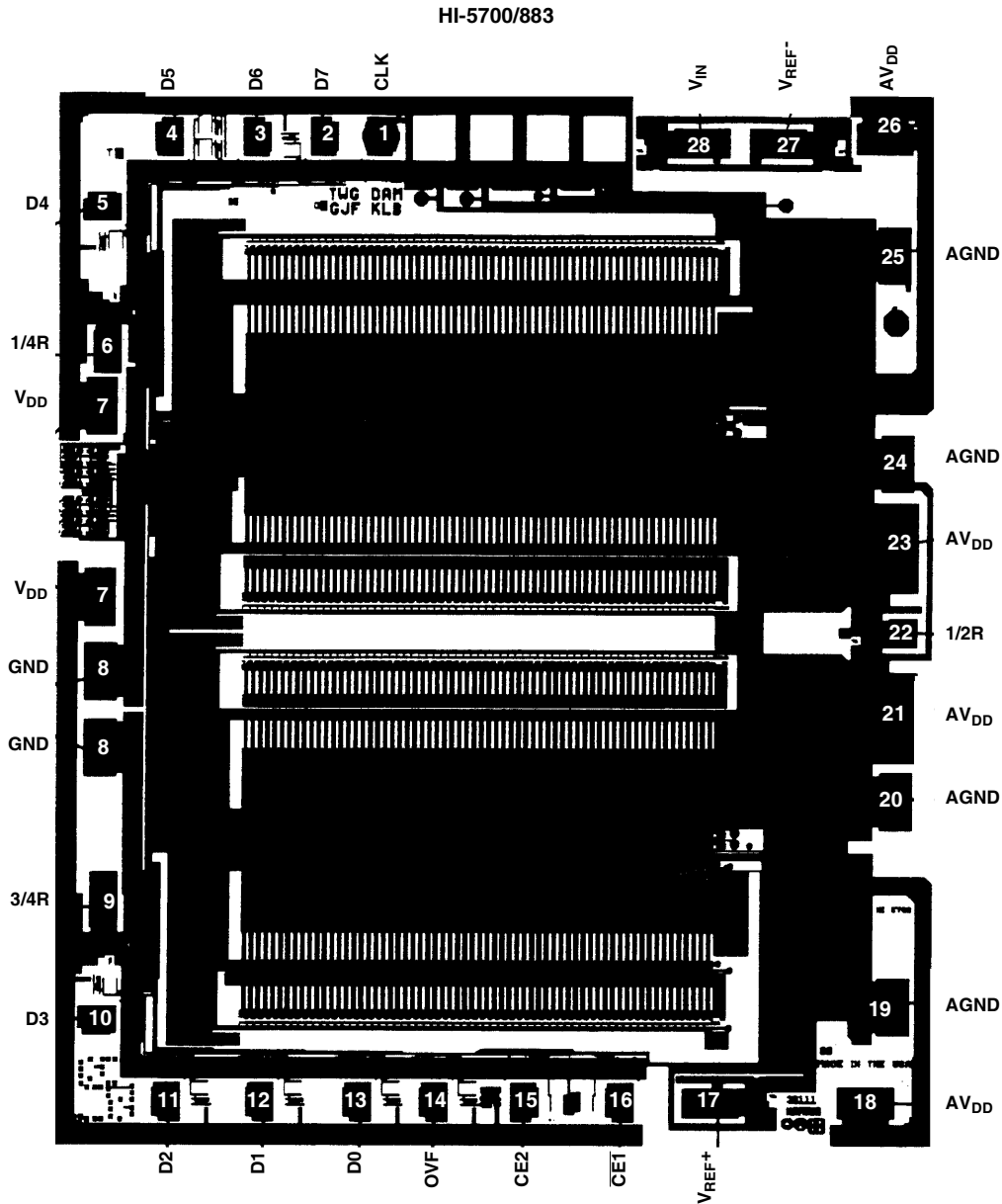
**DIE ATTACH:**

Material: Gold Silicon Eutectic Alloy  
 Temperature: Ceramic DIP - 460°C (Max)

**WORST CASE CURRENT DENSITY:**

3.05 x 10<sup>4</sup> A/cm<sup>2</sup>

**Metallization Mask Layout**



Timing Waveforms

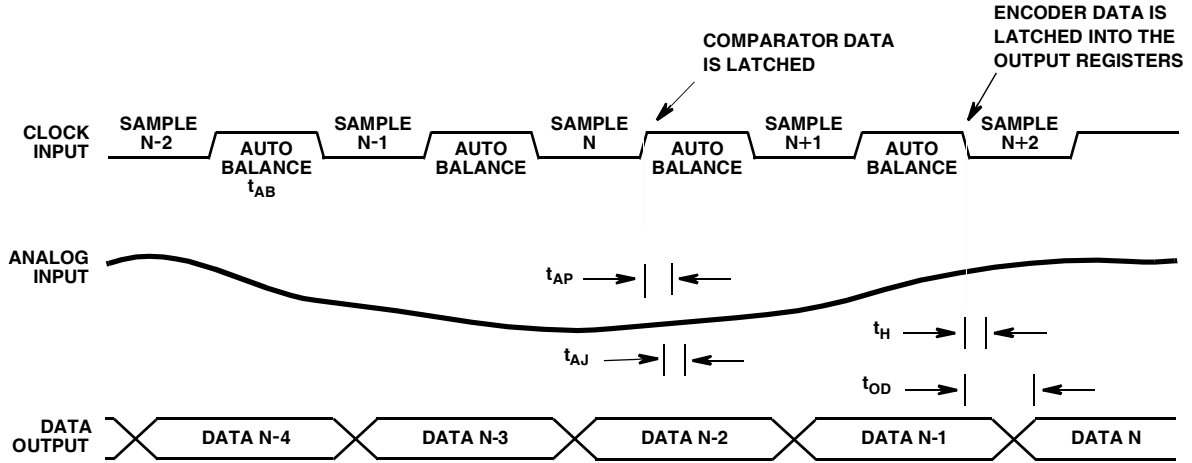


FIGURE 1. INPUT-TO-OUTPUT TIMING

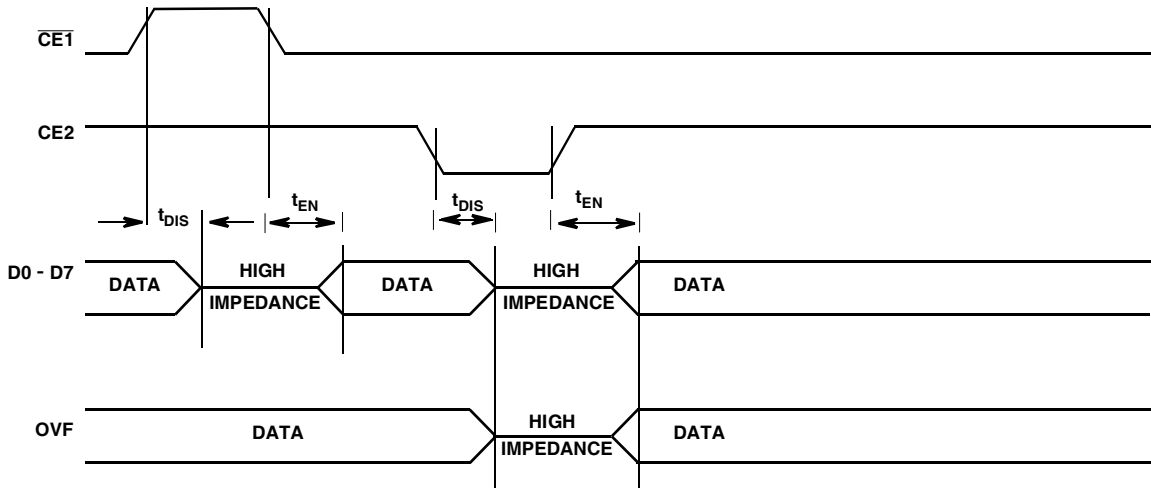


FIGURE 2. OUTPUT ENABLE TIMING

# HI-5700/883

## Burn-In Circuit

HI-5700/883 CERAMIC DIP

