

NOT RECOMMENDED FOR NEW DESIGNS

HI-5700/883

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

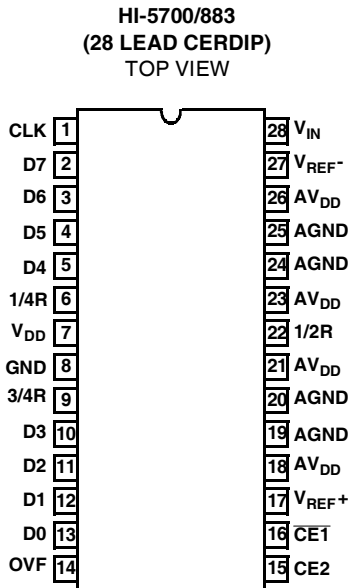
Description

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 ± 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.

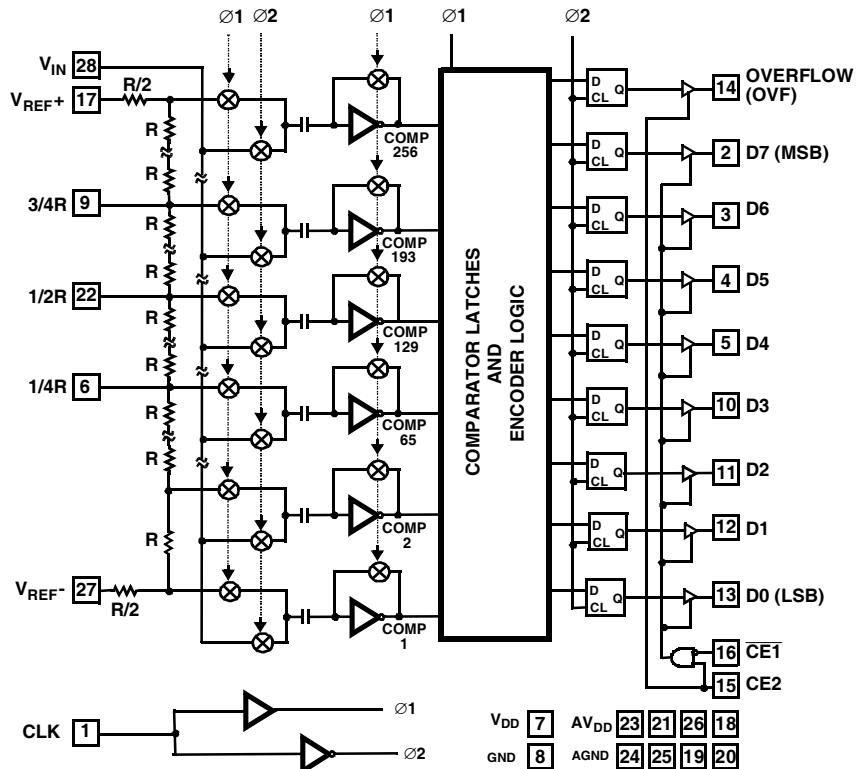
Ordering Information

| 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 _{DD} | 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 _{REF+} | Reference Voltage Positive Input |
| 18 | AV _{DD} | Analog Power Supply, +5V |
| 19 | AGND | Analog Ground |
| 20 | AGND | Analog Ground |
| 21 | AV _{DD} | Analog Power Supply, +5V |
| 22 | 1/2R | 1/2 Point of Reference Ladder |
| 23 | AV _{DD} | Analog Power Supply, +5V |
| 24 | AGND | Analog Ground |
| 25 | AGND | Analog Ground |
| 26 | AV _{DD} | Analog Power Supply, +5V |
| 27 | V _{REF-} | Reference Voltage Negative Input |
| 28 | V _{IN} | 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 | θ_{JA} | θ_{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 | |
| ACCURACY | | | | | | | |
| 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 |
| ANALOG INPUT | | | | | | | |
| 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 |
| REFERENCE INPUT | | | | | | | |
| 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: $V_{DD} = +5.0V$; $V_{REF+} = +4.0V$; $V_{REF-} = GND = AGND = 0V$; $F_S =$ Specified Clock Frequency at 50% Duty Cycle; $C_L = 30pF$; Unless Otherwise Specified.

| PARAMETERS | SYMBOL | CONDITIONS | GROUP A SUBGROUP | TEMPERATURE | LIMITS | | UNIT |
|-------------------------------|--------------|--------------------------|------------------|---------------|--------|------------|---------|
| | | | | | MIN | MAX | |
| DIGITAL INPUTS | | | | | | | |
| 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 | - | ± 1 | μA |
| | | | 2, 3 | +125°C, -55°C | - | ± 1 | μA |
| DIGITAL OUTPUTS | | | | | | | |
| Output Leakage | I_{OZ} | $CE2 = 0V, V_O = 0V, 5V$ | 1 | +25°C | - | ± 1.0 | μA |
| | | | 2, 3 | +125°C, -55°C | - | ± 1.0 | μA |
| 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 |
| POWER SUPPLY REJECTION | | | | | | | |
| Offset Error PSRR | ΔVOS | $V_{DD} = 5V \pm 10\%$ | 1 | +25°C | - | ± 2.75 | LSB |
| | | | 2, 3 | +125°C, -55°C | - | ± 5.5 | LSB |
| Gain Error PSRR | ΔFSE | $V_{DD} = 5V \pm 10\%$ | 1 | +25°C | - | ± 2.75 | LSB |
| | | | 2, 3 | +125°C, -55°C | - | ± 5.5 | LSB |
| POWER SUPPLY CURRENT | | | | | | | |
| 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: $V_{DD} = +5.0V$; $V_{REF+} = +4.0V$; $V_{REF-} = GND = AGND = 0V$; $F_S =$ 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: SiO₂
 Thickness: 8kÅ ± 1kÅ

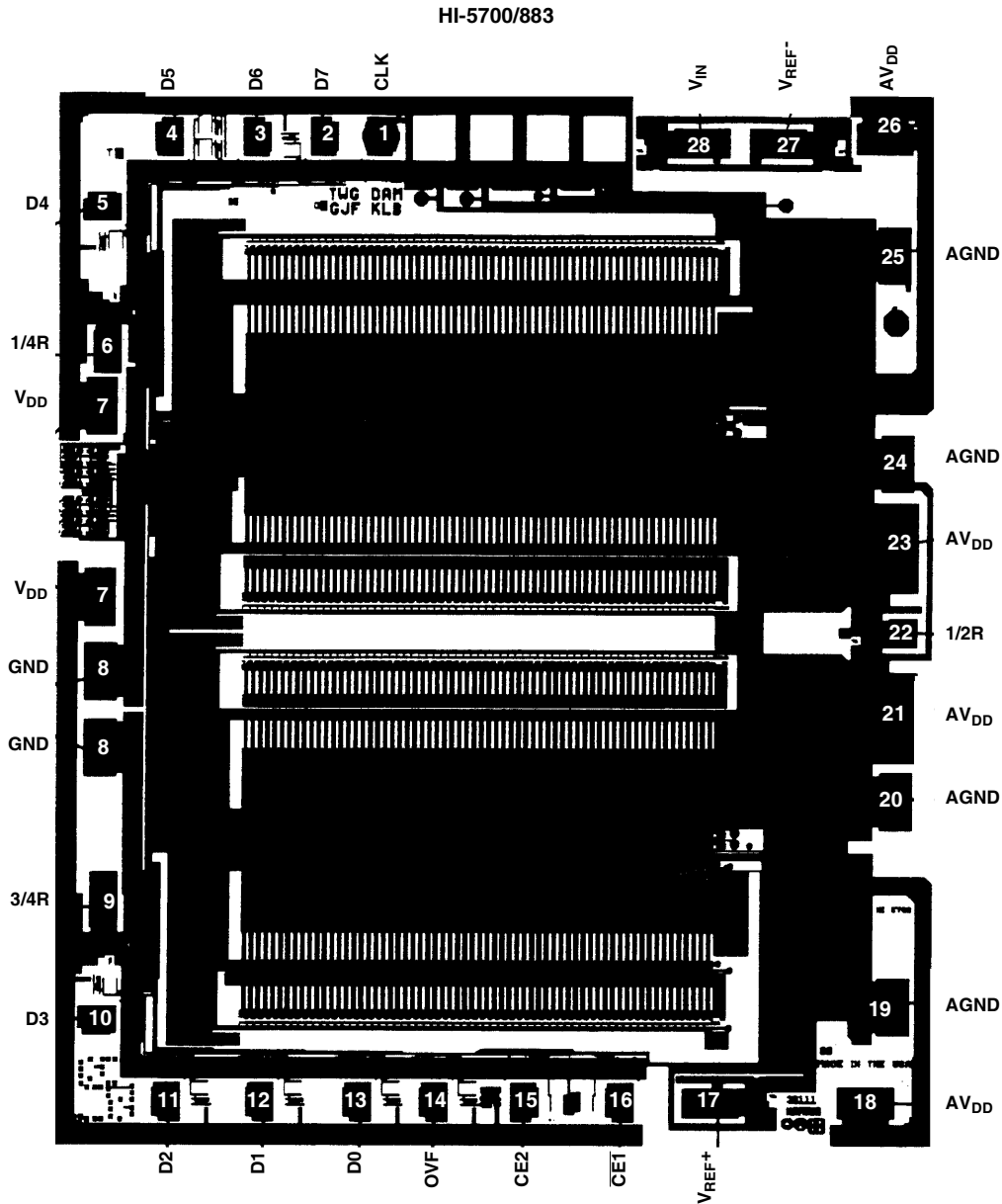
DIE ATTACH:

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

WORST CASE CURRENT DENSITY:

3.05 x 10⁴ A/cm²

Metallization Mask Layout



Timing Waveforms

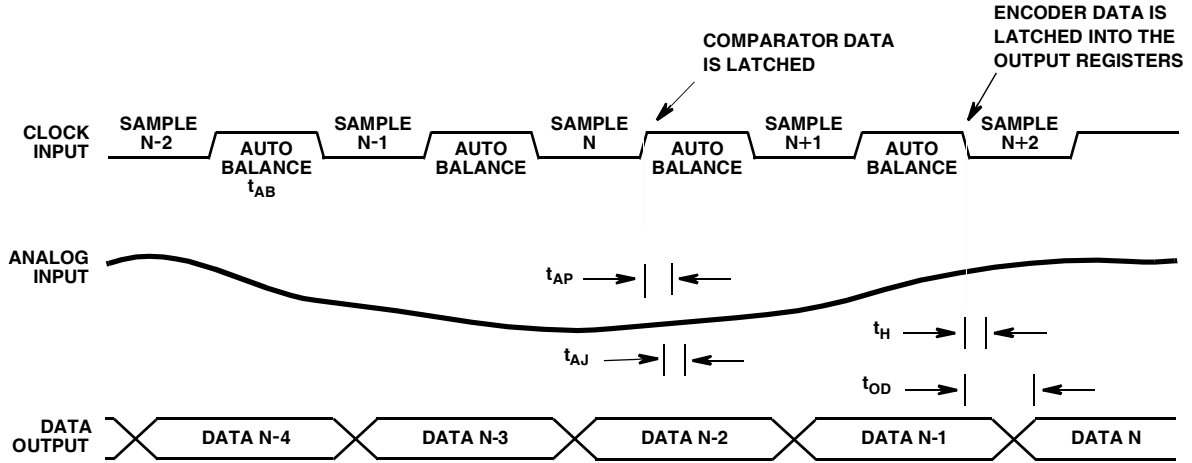


FIGURE 1. INPUT-TO-OUTPUT TIMING

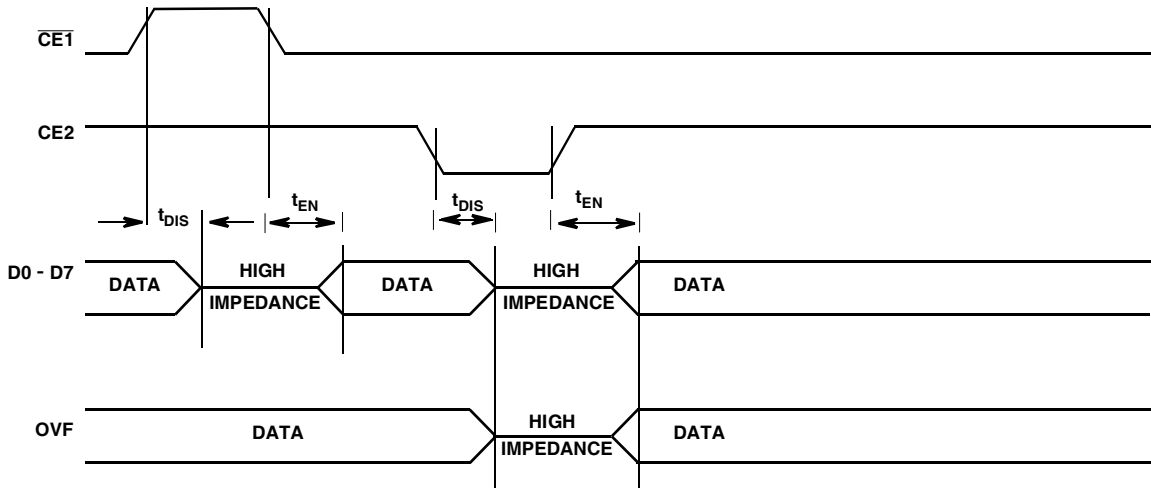


FIGURE 2. OUTPUT ENABLE TIMING

HI-5700/883

Burn-In Circuit

HI-5700/883 CERAMIC DIP

