

**1.1 Scope.**

This specification covers the detail requirements for a hybrid quad 12-bit voltage output CMOS D/A converter with individual DAC reference inputs.

**1.2 Part Number.**

The complete part number per Table 1 of this specification is as follows:

| Device | Part Number  |
|--------|--------------|
| -1     | AD394SD/883B |
| -2     | AD394TD/883B |

**1.2.3 Case Outline.**

See Appendix 1 of General Specification ADI-H-1000: package outline: DH-28A.

**1.3 Absolute Maximum Ratings.** ( $T_A = +25^\circ\text{C}$  unless otherwise noted)

|                                       |       |  |
|---------------------------------------|-------|--|
| $+V_S$ to DGND                        | ..... | -0.3V to +17V                                      |
| $-V_S$ to DGND                        | ..... | +0.3V to -17V                                      |
| Digital Inputs (Pins 1-16) to DGND    | ..... | -0.3V to +7V                                       |
| $V_{REFIN}$ to DGND                   | ..... | $\pm 25V$  |
| AGND to DGND                          | ..... | -0.3V to $+V_S$                                    |
| Analog Outputs (Pins 18, 21, 24, 27)  | ..... | Indefinite   |
|                                       |       | Short to AGND or DGND Momentary Short to $\pm V_S$ |
| Operating Temperature Range (Ambient) | ..... | $-55^\circ\text{C}$ to $+125^\circ\text{C}$        |
| Storage Temperature Range             | ..... | $-65^\circ\text{C}$ to $+150^\circ\text{C}$        |
| Lead Temperature (Soldering 10secs)   | ..... | $+300^\circ\text{C}$                               |

**1.5 Thermal Characteristics.**

Thermal Resistance  $\theta_{JC} = 8^\circ\text{C}/\text{W}$  typ  
 $\theta_{JA} = 25^\circ\text{C}/\text{W}$  typ

# AD394—SPECIFICATIONS

Table 1.

| Test   | Symbol   | Device            | Design Limit<br>@ 25°C/(−55°C to<br>+125°C) | Sub<br>Group<br>1 | Sub<br>Group<br>2, 3 | Sub<br>Group<br>4 | Test Condition <sup>1</sup>  | Units                         |
|--|--|-------------------|---|-------------------|----------------------|-------------------|--|-------------------------------|
| Data Input Voltage High<br>End Point Electrical  | V <sub>IH</sub>                                      | −1, 2<br>−1, 2    | 2.4/(2.4)<br>5.5/(5.5)                      |                   |                      | 2.4               | Test Limits Apply<br>to Pins 1–12. Design<br>Limits Apply to<br>Pins 13–16.  | + V min<br>+ V max<br>+ V min |
| Data Input Voltage Low<br>End Point Electrical   | V <sub>IL</sub>                                      | −1, 2<br>−1, 2    | 0.0/(0.0)<br>0.8/(0.8)                      |                   |                      | 0.8               | Test Limits Apply<br>to Pins 1–12. Design<br>Limits Apply to<br>Pins 13–16.  | + V min<br>+ V max<br>+ V min |
| Input Current High   | I <sub>IH</sub>                                      | −1, 2             | 40/(40)                                     |                   |                      | 40                | V <sub>IN</sub> = 0V or +5V  | ± μA max                      |
| Input Current Low<br>End Point Electrical  | I <sub>IL</sub><br>I <sub>IH</sub> , I <sub>IL</sub> | −1, 2<br>−1, 2    | 40/(40)                                     | 40                |                      | 40                | V <sub>IN</sub> = 0V or +5V  | ± μA max                      |
| Output Voltage Range <sup>2</sup>  | V <sub>OUT</sub>                                     | −1, 2             | 11/(11)<br>11/(11)                          |                   |                      | 10<br>10          | Output Voltage<br>Equals −REFIN to +REFIN  | − V min<br>+ V max            |
| Output Current Range   | I <sub>OR</sub>                                      | −1, 2             | 5/(5)                                       |                   |                      |                   |  | ± mA min                      |
| Gain Error<br>End Point Electrical   | A <sub>E</sub>                                       | −1<br>−2<br>−1, 2 | 0.1<br>0.05                                 | 0.1<br>0.2        |                      | 0.05              | External + 10.000V REF<br>Bit Code = 1111 1111 1111  | ± %FSR <sup>3</sup> max       |
| Gain Error Temperature<br>Coefficient  | TC <sub>AE</sub>                                     | −1<br>−2          | /(10)<br>/(5)                               |                   | 10<br>5              |                   | External + 10.000V REF<br>Bit Code = 1111 1111 1111  | ± ppm/°C max                  |
| Offset Error<br>End Point Electrical   | V <sub>OS</sub>                                      | −1<br>−2<br>−1, 2 | 0.05<br>0.025                               | 0.05<br>0.1       |                      | 0.025             | External + 10.000V REF<br>Bit Code = 0000 0000 0000  | ± %FSR max                    |
| Offset Temperature<br>Coefficient  | TC <sub>BPZ</sub>                                    | −1<br>−2          | /(10)<br>/(5)                               |                   | 10<br>5              |                   | External + 10.000V REF<br>Bit Code = 0000 0000 0000  | ± ppm/°C max                  |
| Differential Linearity<br>Error <sup>4</sup><br>End Point Electrical                               | DLE  | −1<br>−2<br>−1, 2 | 3/4<br>1/2                                  | 3/4<br>1.5        | 1<br>1               | 1/2               |  | ± LSB max                     |
| Linearity Error <sup>5</sup><br>End Point Electrical   | TC <sub>LE</sub>                                     | −1<br>−2<br>−1, 2 | 3/4<br>1/2                                  | 3/4<br>1/2<br>1   | 3/4<br>1/2           |                   |  | ± LSB max                     |
| Power Supply Voltages <sup>2</sup>   | V <sub>S</sub>                                       | −1, 2<br>−1, 2    | 13.5/(13.5)<br>16.5/(16.5)                  | 15<br>15          | 15<br>15             |                   |  | − V min<br>V max              |
| Power Supply Currents  | I <sub>CC</sub><br>I <sub>EE</sub>                   | −1, 2             | 28/(35)<br>22/(22)                          |                   |                      | 28<br>22          | Data Input Bits =<br>1111 1111 1111<br>R <sub>L</sub> = ∞<br>Data Input Bits =<br>1111 1111 1111<br>R <sub>L</sub> = ∞ | − mA max<br>+ mA max          |
| Power Supply Gain<br>Sensitivity Δ Gain/<br>ΔV <sub>S</sub> (+V <sub>S</sub> and −V <sub>S</sub> ) | PSRR   | −1, 2             | 0.006                                       |                   |                      | 0.006             | Input Bits =<br>1111 1111 1111<br>V <sub>S</sub> = ±15V ±10%   | ± %FS/%                       |
| Timing Specifications<br>Chip Select   | t <sub>CS</sub>                                      | −1, 2             | 170   |                   |                      |                   | See Figure 1   | ns min                        |
| Data Access Time   | t <sub>DA</sub>                                      | −1, 2             | 0   |                   |                      |                   | See Figure 1   | ns min                        |
| Data Setup Time  | t <sub>DS</sub>                                      | −1, 2             | 150   |                   |                      |                   | See Figure 1   | ns min                        |
| Data Hold Time   | t <sub>DH</sub>                                      | −1, 2             | 5   |                   |                      |                   | See Figure 1   | ns min                        |

NOTES

<sup>1</sup>T<sub>A</sub> = +25°C and ±V<sub>S</sub> = ±15V, V<sub>REFIN</sub> = +10V.

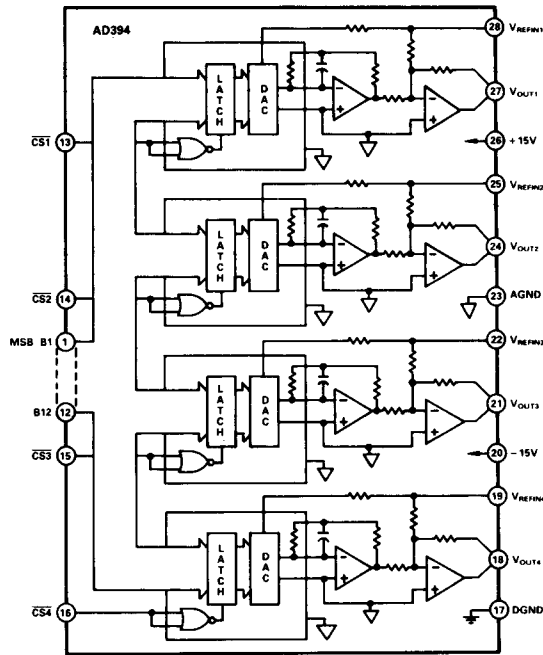
<sup>2</sup>The AD394 can be used with supplies as low as ±11.4V. See page 6, Figure 10 of product data sheet.

<sup>3</sup>FSR means Full-Scale Range and is equal to 20V for a ±10V bipolar range and 10V for 0 to 10V unipolar range.

<sup>4</sup>Monotonicity is tested for over the full military temperature.

<sup>5</sup>Integral nonlinearity is a measure of the maximum deviation from a straight line passing through the end points of the transfer function.

## 3.2.1 Functional Block Diagram and Terminal Assignments.



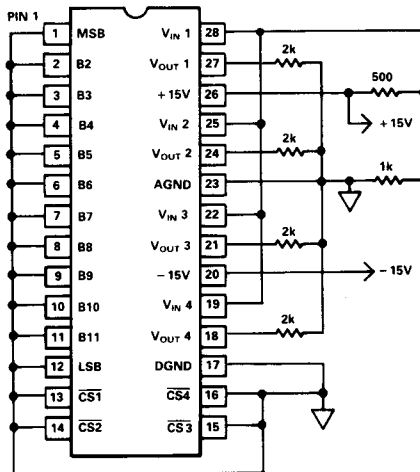
AD394 Functional Block Diagram

## 3.2.4 Microcircuit Technology Group.

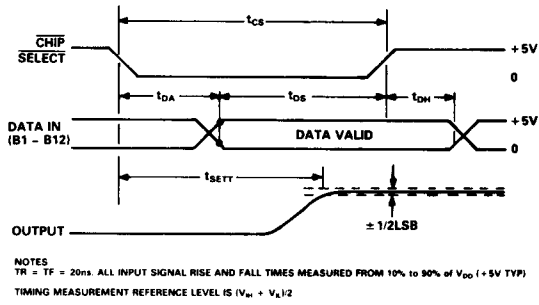
This microcircuit is covered by technology group (I).

## 4.2.1 Life Test/Burn-In Circuit.

Steady state life test is per MIL-STD-883 Method 1005. Burn-in is per MIL-STD-883 Method 1015 test condition (B).



# AD394



WRITE MODE                      HOLD MODE                      MODE SELECTION  
CS LOW, DAC RESPONDS TC    CS HIGH, DATA BUS (db0-db11) IS  
DATA BUS (db0-db11) INPUTS    LOCKED OUT, DAC HOLDS LAST DATA  
PRESENT WHEN CS ASSUMED    HIGH STATE

Figure 1. Timing Diagram

Table 2. DAC Select Matrix

| CS1 | CS2 | CS3 | CS4 | Operation                      |
|-----|-----|-----|-----|--------------------------------|
| 1   | 1   | 1   | 1   | All DACs Latched               |
| 0   | 1   | 1   | 1   | Load DAC 1 From Data Bus       |
| 1   | 0   | 1   | 1   | Load DAC 2 From Data Bus       |
| 1   | 1   | 0   | 1   | Load DAC 3 From Data Bus       |
| 1   | 1   | 1   | 0   | Load DAC 4 From Data Bus       |
| 0   | 0   | 0   | 0   | All DACs Simultaneously Loaded |

Table 3. AD394 Bipolar Code Table

| DATA INPUT     | ANALOG OUTPUT   | ANALOG OUTPUT VOLTAGE $V_{REFIN} = +10$ VOLTS |
|----------------|---|---|
| 1111 1111 1111 | $+1 \cdot (V_{REFIN}) \left\{ \frac{2047}{2048} \right\}$ | +9.9951V      + FULL SCALE - 1LSB             |
| 1100 0000 0000 | $+1 \cdot (V_{REFIN}) \left\{ \frac{1024}{2048} \right\}$ | +5.000V      + 1/2 SCALE                      |
| 1000 0000 0001 | $+1 \cdot (V_{REFIN}) \left\{ \frac{1}{2048} \right\}$    | +4.88mV      + 1LSB                           |
| 1000 0000 0000 | $+1 \cdot (V_{REFIN}) \left\{ \frac{0}{2048} \right\}$    | +0.000V      ZERO                             |
| 0111 1111 1111 | $-1 \cdot (V_{REFIN}) \left\{ \frac{1}{2048} \right\}$    | -4.88mV      - 1LSB                           |
| 0100 0000 0000 | $-1 \cdot (V_{REFIN}) \left\{ \frac{1024}{2048} \right\}$ | -5.000V      - 1/2 SCALE                      |
| 0000 0000 0000 | $-1 \cdot (V_{REFIN}) \left\{ \frac{2048}{2048} \right\}$ | -10.000V      - FULL SCALE                    |