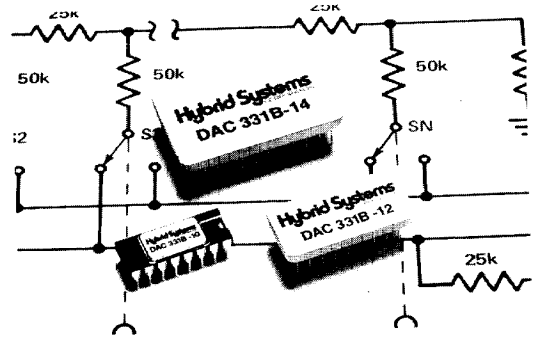**Sipex** Corporation
SIGNAL PROCESSING EXCELLENCE

## 12 & 14 BIT MULTIPLYING DACs

## FEATURES
- Accuracy/resolution to 14-bits
- 2 and 4-quadrant multiplication
- −55°C to +125°C operation
- Ladders and feedback resistors trimmed to ±5% absolute
- Low power
- Single power supply



## DESCRIPTION

The DAC331 Series includes 12 and 14-bit multiplying digital-to-analog (DAC) converters. Linearity error of ±½ LSB maximum is standard for all models. All models are capable of both 2-quadrant (unipolar) and 4-quadrant (bipolar) multiplication and 2-quadrant division. Models are available in commercial/industrial grade ("C" versions) for 0 to +70°C operation. "B" versions are processed to the requirements of MIL-STD-883 Rev. C, Level B and are specified for use over a wide, −55°C to +125°C, temperature range.

Ultra-stable R/2R thin-film resistor ladder networks are trimmed to 25K/50KΩ absolute. Each DAC331 includes a 25KΩ feedback resistor (for use with external op amp) that closely tracks the R/2R ladder. Linearity tempco is a low ±2 ppm/°C FSR. Gain tempcos are for 12-and 14-bit models.

Each DAC331 Series converter operates from a single, +5V power supply. Power consumed is less than 30 mW. All models are TTL/DTL and CMOS compatible.

Uses for DAC331 Series converters include digital attenuation of AC and DC voltages, digital gain control, and stroke generators for CRT graphics displays. DAC331's low power is well suited to battery powered equipment applications.

**7**

## FUNCTIONAL DIAGRAM
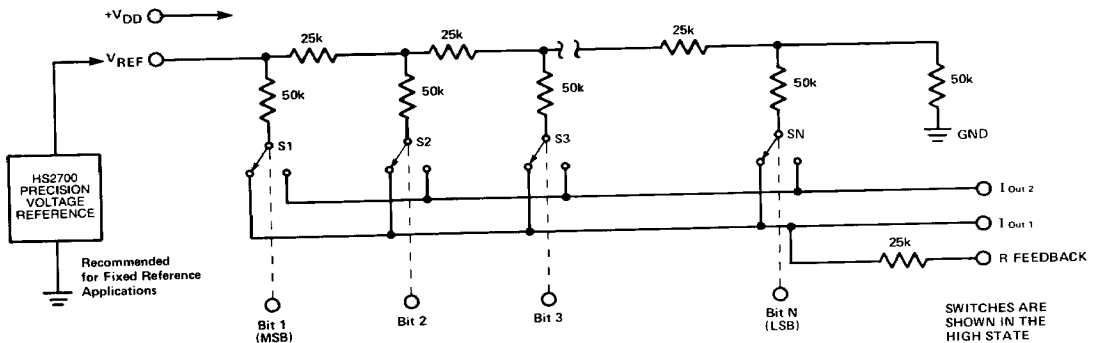
# SPECIFICATIONS

(Typical @ +25°C unless otherwise noted; Using $V_{DD}$ nominal power supply, $V_{REF}$ = +10V)

| SERIES | DAC331 |
|---|---|
| TYPE | Multiplying, Current Output |

**DIGITAL INPUT**

| | |
|---|---|
| Resolution: | |
| –12 models | 12 Bits |
| –14 models | 14 Bits |
| 2-Quad. Unipolar Coding | Binary |
| 4-Quad. Bipolar Coding | Offset Binary |
| Logic Compatibility | DTL, TTL, 5V CMOS |
| Logic Thresholds[1] | $V_{IH}$=3.0V (min), |
| | $V_{IL}$=1.0V (max) |
| Input Leakage Current | ±1μA (max) @ |
| | $0V \leq V_{IN} \leq V_{DD}$ |

**REFERENCE INPUT**

| | |
|---|---|
| Voltage Range | ±25V (max) |
| Input Impedance | 25KΩ ± 1% (nom)[2] |

**ANALOG OUTPUT**

| | |
|---|---|
| Gain Accuracy[3] | 40μA/V ± 0.1% F.S.R.,typ; |
| | ±1.0% F.S.R., max |
| Offset[4] | 50μV (max) |
| Small Signal | |
| 3 dB Bandwidth | 600 kHz (min) |
| Output Capacitance | |
| $C_{out_1}$ | 100pF (max) all inputs high |
| $C_{out_2}$ | 65pF (max) all inputs high |
| $C_{out_1}$ | 65pF (max) all inputs low |
| $C_{out_2}$ | 100pF (max) all inputs low |

**STATIC PERFORMANCE**

| | |
|---|---|
| Integral Linearity (all models) | ±½ LSB (max) |
| Differential Linearity (all models) | ±½LSB, typ; ±1LSB, max |

**DYNAMIC PERFORMANCE**

| | |
|---|---|
| Major Code Transition Settling to ± 0.05% | |
| 12 and 14 Bit models | 3.0μS (max) |
| Reference Feedthrough Error ($V_{REF}$ = 20Vpp @ 10 kHz) | 10mVpp |

**STABILITY[4] (Over Specified Temp. Range)**

| | |
|---|---|
| Scale Factor[5] | |
| 12 and 14 Bit models | ±3ppm/°C F.S.R. (max) |
| Linearity (all models) | ±3ppm/°C F.S.R. (max) |
| Differential Linearity (all models) | ±2ppm/°C F.S.R. (max) |

**POWER SUPPLY ($V_{DD}$)[6]**

| | |
|---|---|
| Voltage Range @ Current | +5V (nom); +4.75V to +10V @ < 1mA |
| Rejection Ratio | 0.005%/% (max) |
| Total Dissipation (inputs at GND) | 30mW (max) |

**TEMPERATURE RANGE**

| | |
|---|---|
| Specified: | |
| –C Versions | 0°C to +70°C |
| –B Versions | –55°C to +125°C |
| Operating (all models) | –55°C to +125°C |
| Storage (all models) | –65°C to +150°C |

**MECHANICAL**

| | |
|---|---|
| Case Style | metal |

**CAUTION:** ESD (Electro-Static Discharge) sensitive device. Permanent damage may occur when unconnected devices are subjected to high energy electrostatic fields. Unless otherwise noted, the voltage at any digital input should never exceed the supply voltage by more than 0.5 volts or go below – 0.5 volts. Power supply should come up before, or at the same time, as the digital input supply.
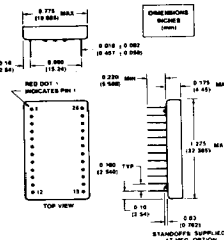
## 18- & 24-Pin Case Envelope Dimensions

### 12-Bit models
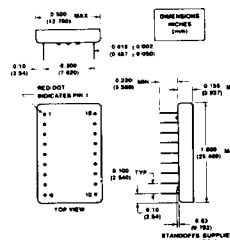


| PIN | FUNCTION | PIN | FUNCTION |
|---|---|---|---|
| 1 | I OUT 1 | 18 | R FEEDBACK |
| 2 | I OUT 2 | 17 | V REF |
| 3 | GND | 16 | +V_DD |
| 4 | Bit 1 (MSB) | 15 | Bit 12 (LSB) |
| 5 | Bit 2 | 14 | Bit 11 |
| 6 | Bit 3 | 13 | Bit 10 |
| 7 | Bit 4 | 12 | Bit 9 |
| 8 | Bit 5 | 11 | Bit 8 |
| 9 | Bit 6 | 10 | Bit 7 |

### 14-Bit models



| PIN | FUNCTION | PIN | FUNCTION |
|---|---|---|---|
| 1 | R FEEDBACK | 24 | V_REF |
| 2 | I OUT 2 | 23 | +V_DD |
| 3 | I OUT 1 | 22 | BIT 5 |
| 4 | N.C. | 21 | BIT 6 |
| 5 | BIT 1 (MSB) | 20 | BIT 7 |
| 6 | BIT 2 | 19 | BIT 8 |
| 7 | BIT 3 | 18 | BIT 9 |
| 8 | BIT 4 | 17 | BIT 10 |
| 9 | N.C. | 16 | BIT 11 |
| 10 | N.C. | 15 | BIT 12 |
| 11 | N.C. | 14 | BIT 13 |
| 12 | GROUND | 13 | BIT 14 (LSB) |

Note: N.C. means no connection

## NOTES:

1. The switching threshold is typically $V_{DD}$/2.
2. 10K Ω input impedance available. Consult factory.
3. Using internal feedback resistor.
4. Using the internal $R_{feedback}$ with nulled external amplifier in a constant 25°C ambient. (Offset doubles every 10°C).
5. The DAC331 Series is designed to be used only in those applications where the current output is virtual ground; i.e., the summing junction of an op amp in the inverting mode. The internal feedback resistor (R Feedback) must be used to achieve temperature tracking.
6. The power supply voltage must not exceed + 10V.
7. In case of discrepancy between package shown in photograph and package outline dimension, the mechanical outline is correct.

# ORDERING INFORMATION

| MODEL NUMBER | DESCRIPTION |
|---|---|
| DAC331C-12-1 | Comm, 12-Bit, +5V Operation |
| DAC331B-12-1 | Mil, 12-Bit, +5V Operation |
| DAC331C-14-1 | Comm, 14-Bit, +5V Operation |
| DAC331B-14-1 | Mil, 14-Bit, +5V Operation |

"C" models are commercially processed.
"B" models are processed to MIL-STD-883 Rev. C, Level B.