Sipex Corporation
SIGNAL PROCESSING EXCELLENCE

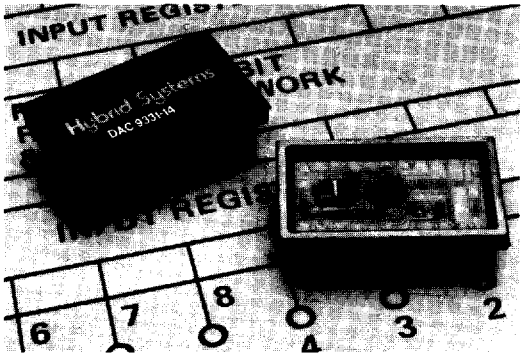
DAC9331-14

T-51-09-90

14-BIT MULTIPLYING DAC

FEATURES

- 14-bit resolution and accuracy
- 2 and 4-quadrant multiplication
- Precision laser trimmed ladder
- Low power
- Single power supply operation
- Reliable



DESCRIPTION

The DAC9331-14 is a low cost 14-bit multiplying digital-to-analog converter packaged in a unique 24-pin double DIP. Capable of 2 and 4-quadrant multiplication, the unit is TTL/DTL and CMOS compatible with power consumption less than 30mW. Power supply options include +5V (-1) or +15V (-2). Outstanding features of the DAC9331-14 include:

True 14-Bit Performance — Up to 14-bit resolution and accuracy over the 0 to 70°C operating range.

2 And 4-Quadrant Multiplication — Reference input range to ±25 volts.

Low Power — CMOS technology provides less than 30mW total power dissipation — a real battery saver.

Reliability Plus — Packaged in a unique enclosure which has undergone extensive environmental testing during its development, the DAC9331-14 is continuously monitored during all assembly and test operations by our quality control organization.

Reliability is enhanced by batch-processed, precision laser-trimmed resistor networks fabricated in our own facility. Similar to monolothic circuits, the networks are processed and functionally trimmed to assure consistent performance. Networks are glass passivated to assure reliability under adverse environmental conditions.

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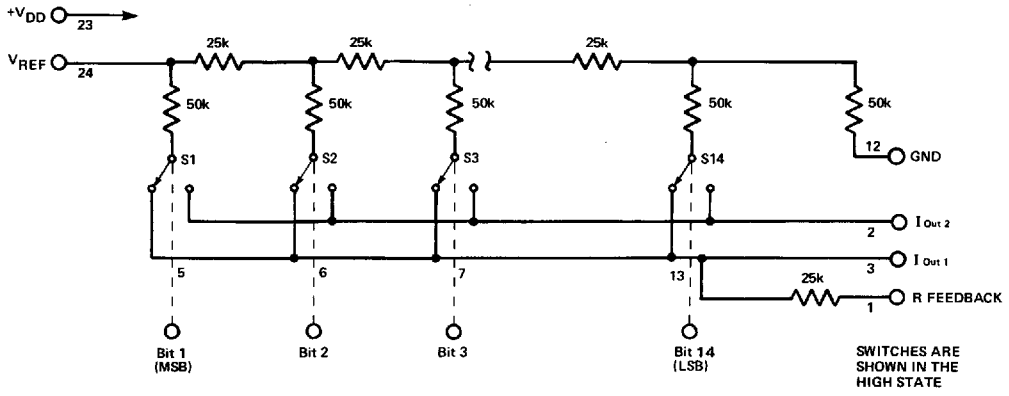
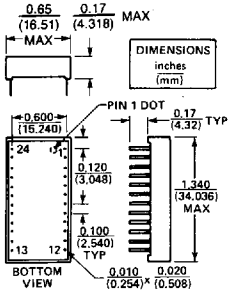
FUNCTIONAL DIAGRAM



SPECIFICATIONS

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

MODEL	DAC9331-14
TYPE	Multiplying
DIGITAL INPUT	
Resolution	14-Bits
2-Quad. Unipolar Coding	Binary
4-Quad. Bipolar Coding	Offset Binary
Logic Compatibility	DTL, TTL, CMOS
Logic Thresholds	V_{IH}=3.5V (min), V_{IL}=1.0V(max)[1]
Input Leakage Current	±1μA (max)
REFERENCE INPUT	
Voltage Range	±25V (max)
Input Impedance	25kΩ
ANALOG OUTPUT	
Gain Accuracy[2]	0.1%
Offset[3]	50μV (max)
Output Leakage	40nA (max)
Small Signal 3dB Bandwidth	600kHz (min)
Output Capacitance	
C_{out1}	100pF (max) all inputs high
C_{out2}	30pF (max) all inputs high
C_{out1}	30pF (max) all inputs low
C_{out2}	100pF (max) all inputs low
STATIC PERFORMANCE	
Integral Linearity[4]	±½LSB (max)
Differential Linearity	±½LSB (typ), ±1LSB (max)
DYNAMIC PERFORMANCE	
Major Carry Transition Settling to ±0.05%	3.0μS (max)
Reference Feedthrough Error (Vref=20Vpp @ 10kHz)	10mVpp
STABILITY[3] (Over Specified Temp. Range)	
Scale Factor[5]	±3ppm/°C F.S.R. (max)
Linearity	±3ppm/°C F.S.R. (max)
Differential Linearity	±2ppm/°C F.S.R. (max)
POWER SUPPLY (V_{DD})[6]	
Voltage Range @ Current	
-1 Option	+5V (nom); +4.75V to +7V @ <1mA
-2 Option	+15V (nom); +11.5V to +15,5V @ 2mA
Rejection Ratio	0.005%/% (typ), 0.007%/% (max)
Total Dissipation (inputs at GND)	30mW (max)
TEMPERATURE RANGE	
Operating	0°C to +70°C
Storage	0°C to +85°C
MECHANICAL	
Case Style	24-pin double-DIP
Case Dimensions	



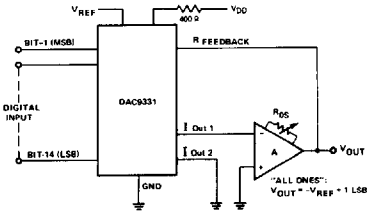
PIN	FUNCTION	PIN	FUNCTION
1	R FEEDBACK	24	V_{REF}
2	I OUT 2	23	$+V_{DD}$
3	I OUT 1	22	BIT 5
4	N.C.	21	BIT 6
5	BIT 1 (MSB)	20	BIT 7
6	BIT 2	19	BIT 8
7	BIT 3	18	BIT 9
8	BIT 4	17	BIT 10
9	N.C.	16	BIT 11
10	N.C.	15	BIT 12
11	N.C.	14	BIT 13
12	GROUND	13	BIT 14 (LSB)

Note: N.C. means no connection

NOTES:
1. The switching threshold is typically V_{DD}/2 for -1 models and V_{DD}/6 for -2 models. The logic input must never exceed V_{DD}/3 for -2 models.
2. Using internal feedback resistor.
3. Using the internal $R_{feedback}$ with nulled external amplifier in a constant 25°C ambient. (Offset doubles every 10°C).
4. Best straight line method of test.
5. The DAC9331-14 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. See APPLICATIONS INFORMATION for recommended circuit configurations.
6. The power supply voltage must not exceed +10V for the -1 versions or +15.5V for the -2 versions.

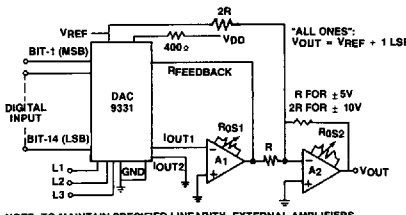
APPLICATIONS INFORMATION

UNIPOLAR OPERATION (2-Quadrant Multiplication)



NOTE: To maintain specified DAC9331 linearity, the external amplifier (A) must be zeroed. Apply an ALL "ZEROS" digital input and adjust R_{OS} for V_{OUT} = 0 ±1mV.

BIPOLAR OPERATION (4-Quadrant Multiplication)



NOTE: TO MAINTAIN SPECIFIED LINEARITY, EXTERNAL AMPLIFIERS (A_1 AND A_2) MUST BE ZEROED. WITH A DIGITAL INPUT OF 10...0 AND V_{REF} SET TO ZERO:
a) SET R_{OS1} FOR V_{O1} = 0
b) SET R_{OS2} FOR V_{OUT} = 0
c) SET V_{REF} TO +10V AND ADJUST R_B FOR V_{OUT} TO BE 0 VOLTS.

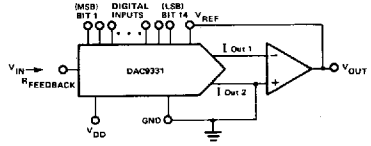
UNIPOLAR OPERATION
Transfer Characteristics

BINARY INPUT	ANALOG OUTPUT
111···111	$-V_{REF}(1-2^{-N})$
100···001	$-V_{REF}(1/2+2^{-N})$
100···000	$\frac{-V_{REF}}{2}$
011···111	$-V_{REF}(1/2-2^{-N})$
000···001	$-V_{REF}(2^{-N})$
000···000	0

BIPOLAR OPERATION
Transfer Characteristics

OFFSET BINARY INPUT	ANALOG OUTPUT
111···111	$-V_{REF}(1-2^{-(N-1)})$
100···001	$-V_{REF}(2^{-(N-1)})$
100···000	0
011···111	$V_{REF}(2^{-(N-1)})$
000···001	$V_{REF}(1-2^{-(N-1)})$
000···000	V_{REF}

ANALOG/DIGITAL DIVISION



Via the above configuration, the DAC331 can be used to divide an analog signal by a digital code (i.e., for digitally controlled gain). The transfer function is given as

$$V_{OUT} = \frac{-V_{IN}}{\frac{\text{Bit 1}}{2^1} + \frac{\text{Bit 2}}{2^2} + \frac{\text{Bit 3}}{2^3} + \cdots + \frac{\text{Bit 14}}{2^{14}}}$$

where the value of each bit is 0 or 1. Division by all "0"s is undefined and causes the op amp to saturate.

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.

ORDERING INFORMATION

MODEL NUMBER	DESCRIPTION
DAC9331-14-1	14-Bit MDAC, +5V Operation
DAC9331-14-2	14-Bit MDAC, +15V Operation

Specifications subject to change without notice.