MAXIM

CMOS 8 Bit Multiplying D/A Converter

T-51-09-08

AD7523

General Description

The AD7523 is high performance multiplying 8 bit digital-to-analog converter (DAC). Low power CMOS technology and low cost make it suitable for a wide range of analog data acquisition and control applications.

Thin-film resistors assure 8 bit resolution with up to 10 bit linearity (L grade) over the full operating temperature range. In addition, all digital inputs are compatible with CMOS logic levels.

Maxim's AD7523 is electrically and pin compatible with the Analog Devices AD7523 and is available in a standard width 16-lead DIP as well as small outline package.

Features

- 8, 9 and 10 Bit Linearity
- ±1.5% Untrimmed Gain Accuracy
- Guaranteed Monotonic
- Low Feedthrough 1/2LSB at 200kHz
- Low Power Consumption
- CMOS Compatible Logic Inputs
- Widely Second Sourced

Applications

Automatic Test Equipment
Digital Calibration Systems
Battery Powered Instruments
Audio Gain Control
Digitally Controlled Filters
Programmable Power Supplies
Motion Control Systems

Ordering Information

PART	TEMP. RANGE	PACKAGE*	ERROR
AD7523JN	0°C to +70°C	Plastic DIP	1/2LSB
AD7523KN	0°C to +70°C	Plastic DIP	1/4LSB
AD7523LN	0°C to +70°C	Plastic DIP	1/8LSB
AD7523JCWE	0°C to +70°C	Small Outline	1/2LSB
AD7523KCWE	0°C to +70°C	Small Outline	1/4LSB
AD7523LCWE	0°C to +70°C	Small Outline	1/8LSB

** All devices — 16 lead packages*

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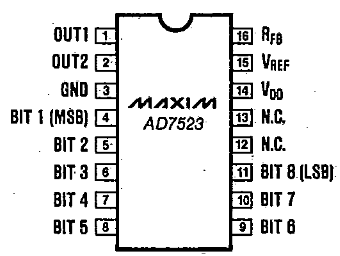
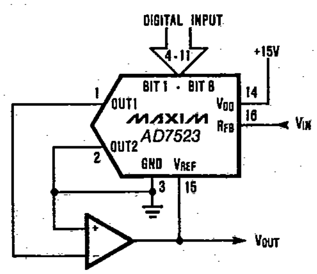
Pin Configuration

Top View



Typical Operating Circuit



$$V_{OUT} = \frac{256}{D}$$

D = Digital Input Code

Digitally Controlled Gain

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ABSOLUTE MAXIMUM RATINGS

V_{DD} to GND .... -0.3V, +17V
V_{REF} to GND .... ±25V
R_{FB} to GND .... ±25V
Digital Input Voltage to GND .... -0.3V, V_{DD}
Output Voltage (OUT1, OUT2) (Note 1) .... -0.3V, V_{DD}
Operating Temperature .... 0°C to +70°C
Storage Temperature .... -65°C to +150°C
Lead Temperature (Soldering 10 secs) .... +300°C
Power Dissipation to +70°C
Plastic DIP 670mW
Small Outline 450mW

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

($T_A = T_{MIN}$ to T_{MAX}, V_{DD} = +15V, V_{REF} = +10V, $V_{OUT1} = V_{OUT2}$ = GND, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.	MAX.	UNITS
DC ACCURACY							
Resolution				8			Bits
Nonlinearity (Note 2)		0.2% FSR = ½LSB 0.1% FSR = ¼LSB 0.05% FSR = ⅛LSB	J K L			±½ ±¼ ±⅛	LSB
Monotonicity				Guaranteed			
Gain Error (Note 2, 3)		Digital Inputs = V_{INH}	T_A = +25°C T_{MIN} to T_{MAX}			±1.5 ±1.8	% FSR
Power Supply Rejection (Note 2)	PSRR	V_{DD} = +14V to +15V	T_A = +25°C T_{MIN} to T_{MAX}			0.02 0.03	%/%V_{DD}
Output Leakage Current		OUT1, Digital Inputs = V_{INL}	T_A = +25°C T_{MIN} to T_{MAX}			±50 ±200	nA
		OUT2, Digital Inputs = V_{INH}	T_A = 25°C T_{MIN} to T_{MAX}			±50 ±200	
V_{REF} Input Resistance	R_{REF}	T_A = +25°C		5	10	20	kΩ
V_{REF} Resistance Tempco		(Note 4)				-500	ppm/°C
AC PERFORMANCE (Note 4)							
Output Current Settling Time to 0.2% of FSR		R_L = 100Ω, Digital Inputs = V_{INH} to V_{INL} and V_{INL} to V_{INH}	T_A = +25°C T_{MIN} to T_{MAX}			150 200	ns
Feedthrough Error		Digital Inputs = V_{INL}, V_{REF} = 20V_{P-P}, 200 KHz	T_A = +25°C T_{MIN} to T_{MAX}			±½ ±1	LSB
Output Capacitance	C_{OUT}	Digital Inputs = V_{INH}	OUT1 OUT2			100 30	pF
		Digital Inputs = V_{INL}	OUT1 OUT2			30 100	
DIGITAL INPUTS							
Logic HIGH Threshold	V_{INH}			+14.5			V
Logic LOW Threshold	V_{INL}					+0.5	V
Input Leakage Current		Digital inputs = 0V or +15V				±1	µA
Input Capacitance, (Note 4)						4	pF
Input Coding		Unipolar Operation (Table 1) Bipolar Operation (Table 2)		Binary Offset Binary			
POWER REQUIREMENTS							
Power Supply Range	V_{DD}	Accuracy not guaranteed over this range.		+5		+16	V
Power Supply Current	I_{DD}	Digital inputs = V_{INH} or V_{INL}				100	µA

Note 1: $V_{OUT1,2}$ may exceed the Absolute Maximum voltage rating if the current is limited to 30mA or less.
Note 2: Using internal feedback resistor (R_{FB}). Full scale range (FSR) = -(V_{REF} - 1LSB) in unipolar mode.
Note 3: Maximum gain change from +25°C to T_{MIN} or T_{MAX} is ±0.3% FSR.
Note 4: Guaranteed by design but not 100% tested.

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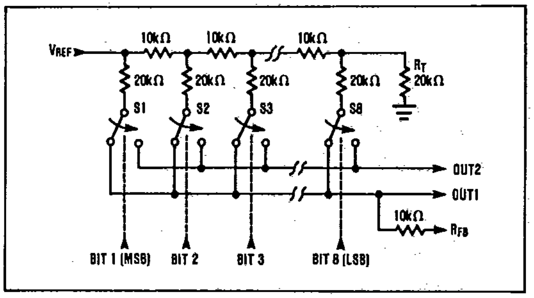
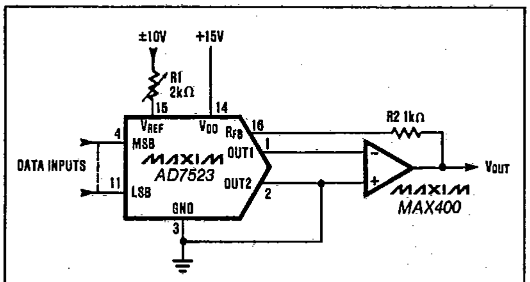
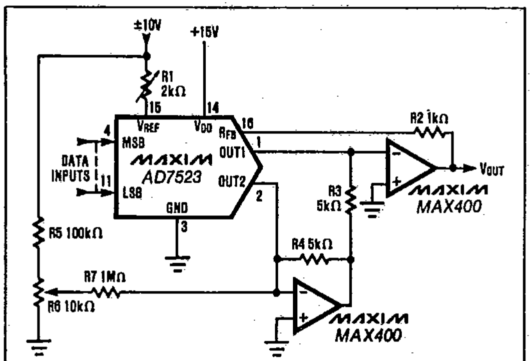


Figure 1. AD7523 Functional Diagram



R1, R2 used only if gain adjustment is required.

Figure 2. Unipolar Binary Operation (2-Quadrant Multiplication)



Notes:
1. R3/R4 match 0.1% or better.
2. R1, R2 used only if gain adjustment is required.
3. R5–R7 used to adjust V_{OUT} = 0V at input code 10000000.

Figure 3. Bipolar (4-Quadrant) Operation

Table 1. Unipolar Binary Code Table

DIGITAL INPUT MSB							LSB	ANALOG OUTPUT
1	1	1	1	1	1	1	1	$-V_{REF}\left(\frac{225}{256}\right)$
1	0	0	0	0	0	0	1	$-V_{REF}\left(\frac{129}{256}\right)$
1	0	0	0	0	0	0	0	$-V_{REF}\left(\frac{128}{256}\right) = -\frac{V_{REF}}{2}$
0	1	1	1	1	1	1	1	$-V_{REF}\left(\frac{127}{256}\right)$
0	0	0	0	0	0	0	1	$-V_{REF}\left(\frac{1}{256}\right)$
0	0	0	0	0	0	0	0	$-V_{REF}\left(\frac{0}{256}\right) = 0$

Note: 1LSB = $(2^{-8})(V_{REF}) = \left(\frac{1}{256}\right)(V_{REF})$

Table 2. Bipolar (Offset Binary) Code Table

DIGITAL INPUT MSB							LSB	ANALOG OUTPUT
1	1	1	1	1	1	1	1	$-V_{REF}\left(\frac{127}{128}\right)$
1	0	0	0	0	0	0	1	$-V_{REF}\left(\frac{1}{128}\right)$
1	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	$+V_{REF}\left(\frac{1}{128}\right)$
0	0	0	0	0	0	0	1	$+V_{REF}\left(\frac{127}{128}\right)$
0	0	0	0	0	0	0	0	$+V_{REF}\left(\frac{128}{128}\right)$

Note: 1LSB = $(2^{-7})(V_{REF}) = \left(\frac{1}{128}\right)(V_{REF})$

Chip Topography