National Semiconductor

AD7520/AD7530 10-Bit, AD7521/AD7531 12-Bit Binary Multiplying D/A Converters

General Description

The AD7520 and the AD7521 are, respectively, 10 and 12-bit binary multiplying digital-to-analog converters. A deposited thin film R-2R resistor ladder divides the reference current and provides the circuit with excellent temperature tracking characteristics (typically 0.0002%/°C linearity error temperature coefficient). The circuit uses CMOS current switches and drive circuitry to achieve low power consumption (30 mW max) and low leakages (200 nA max). The digital inputs are compatible with DTL/TTL logic levels as well as full CMOS logic level swings. This part, combined with an external amplifier and voltage reference, can be used as a standard D/A converter; however, it is also very attractive for multiplying applications (such as digitally controlled gain blocks) since its linearity error is essentially independent of the voltage reference.

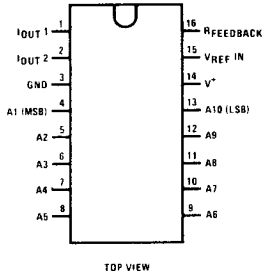
This part is available with 10-bit (0.05%), 9-bit (0.10%), and 8-bit (0.20%) non-linearity. The AD7520L, AD7520K, and AD7520J are direct replacements for the 10-bit resolution AD7520 and AD7530 family, and equivalent to AD7533 family. The AD7521K, AD7521J and AD7521L are direct replacements for the 12-bit resolution AD7521 and AD7531 family. For more information, see DAC1020 data sheet.

Features

- Linearity specified with zero and full-scale adjust only
- Integrated thin film on CMOS structure
- 10-bit or 12-bit resolution
- Low power dissipation 10 mW @ 15V typ
- Accepts variable or fixed reference $-25V \leq V_{REF} \leq +25V$
- 4-quadrant multiplying capability
- Interfaces directly with DTL, TTL and CMOS
- Fast settling time—600 ns typ
- Low feedthrough error—1/2 LSB @ 100 kHz typ

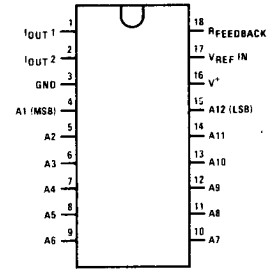
Connection Diagrams

AD7520/AD7530
Dual-In-Line Package



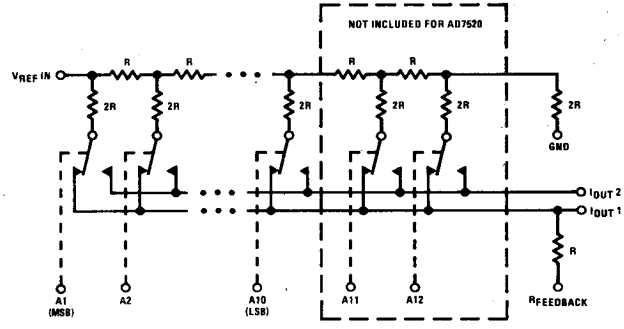
TOP VIEW

AD7521/AD7531
Dual-In-Line Package



TOP VIEW

Equivalent Circuit



Switches shown in digital high state

Ordering Information*

10-BIT D/A CONVERTERS

TEMPERATURE RANGE		0°C to 70°C		−40°C to +85°C		−55°C to +125°C
ACCURACY	0.05%	AD7520LN	AD7530LN	AD7520LD	AD7530LD	AD7520UD
	0.10%	AD7520KN	AD7530KN	AD7520KD	AD7530KD	AD7520TD
	0.20%	AD7520JN	AD7530JN	AD7520JD	AD7530JD	AD7520SD
PACKAGE OUTLINE		N16A		D16C		D16C

12-BIT D/A CONVERTERS

TEMPERATURE RANGE		0°C to 70°C		−40°C to +85°C		−55°C to +125°C
ACCURACY	0.05%	AD7521LN	AD7531LN	AD7521LD	AD7531LD	AD7521UD
	0.10%	AD7521KN	AD7531KN	AD7521KD	AD7531KD	AD7521TD
	0.20%	AD7521JN	AD7531JN	AD7521JD	AD7531JD	AD7521SD
PACKAGE OUTLINE		N18A		D18A		D18A

*Note: Devices ordered using these P/N's will be marked with AD7520 series and DAC102X series numbers.

Absolute Maximum Ratings

V^+ to Gnd	17V
V_{REF} to Gnd	±25V
Digital Input Voltage Range	V^+ to Gnd
DC Voltage at Pin 1 or Pin 2 (Note 3)	−100 mV to V^+
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Operating Temperature Range

	MIN	MAX	UNITS
AD7520LN, AD7520KN, AD7520JN	0	+70	°C
AD7521LN, AD7521KN, AD7521JN	0	+70	°C
AD7530LN, AD7530KN, AD7530JN	0	+70	°C
AD7531LN, AD7531KN, AD7531JN	0	+70	°C
AD7520LD, AD7520KD, AD7520JD	−40	+85	°C
AD7521LD, AD7521KD, AD7521JD	−40	+85	°C
AD7530LD, AD7530KD, AD7530JD	−40	+85	°C
AD7531LD, AD7531KD, AD7531JD	−40	+85	°C
AD7520UD, AD7520TD, AD7520SD	−55	+125	°C
AD7521UD, AD7521TD, AD7521SD	−55	+125	°C

Electrical Characteristics (V^+ = 15V, V_{REF} = 10.000V, T_A = 25°C unless otherwise specified)

PARAMETER	CONDITIONS	AD7520L, AD7520K, AD7520J			AD7521L, AD7521K, AD7521J			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Resolution		10			12			Bits
Linearity Error	$T_{MIN} \le T_A \le T_{MAX}$, $-10V \le V_{REF} \le +10V$, (Note 1) End Point Adjustment Only (See Linearity Error in Definition of Terms)							
10-bit Parts	AD7520L, AD7520U, AD7521L, AD7521U, AD7530L, AD7531L			0.05			0.05	% FSR
9-bit Parts	AD7520T, AD7520K, AD7521T, AD7521K, AD7530K, AD7531K			0.10			0.10	% FSR
8-bit Parts	AD7520S, AD7520J, AD7521S, AD7521J, AD7530J, AD7531J			0.20			0.20	% FSR
Linearity Error Tempco	$-10V \le V_{REF} \le +10V$, (Notes 1 and 2)		0.0002			0.0002		% FS/°C
Full-Scale Error	$-10V \le V_{REF} \le +10V$, (Notes 1 and 2)		0.3			0.3		% FS
Full-Scale Error Tempco	$T_{MIN} < T_A < T_{MAX}$, (Note 2)			0.001			0.001	% FS/°C
Output Leakage Current								
I_{OUT1}	All Digital Inputs Low, $T_{MIN} \le T_A \le T_{MAX}$			200			200	nA
I_{OUT2}	All Digital Inputs High, $T_{MIN} \le T_A \le T_{MAX}$			200			200	nA
Power Supply Sensitivity	All Digital Inputs High, $14V \le V^+ \le 16V$ (*Figure 2* of DAC1020 data sheet)		0.005			0.005		% FS/V
V_{REF} Input Resistance		10	15	20	10	15	20	kΩ
Full-Scale Current Settling Time	R_L = 100Ω from 0 to 99.95% FS							
	All Digital Inputs Switched Simultaneously		500			500		ns
V_{REF} Feedthrough	All Digital Inputs Low, V_{REF} = 20 Vp-p @ 100 kHz			10			10	mVp-p
	D Package (Note 4)		6	9		6	9	mVp-p
	N Package		2	5		2	5	mVp-p
Output Capacitance								
I_{OUT1}	All Digital Inputs Low		40			40		pF
	All Digital Inputs High		200			200		pF
I_{OUT2}	All Digital Inputs Low		200			200		pF
	All Digital Inputs High		40			40		pF
Digital Input	(Note 1)							
Low Threshold	$T_{MIN} < T_A < T_{MAX}$,			0.8			0.8	V
High Threshold	$T_{MIN} < T_A < T_{MAX}$	2.4			2.4			V
Digital Input Current	$T_{MIN} \le T_A \le T_{MAX}$							
	Digital Input High		1	100		1	100	μA
	Digital Input Low		−50	−200		−50	−200	μA
Supply Current	All Digital Inputs High		0.2	1.6		0.2	1.6	mA
	All Digital Inputs Low		0.6	2		0.6	2	mA
Operating Power Supply Range		5		15	5		15	V

Note 1: V_{REF} = ±10V and V_{REF} = ±1V.

Note 2: Using internal feedback resistor.

Note 3: Both I_{OUT1} and I_{OUT2} must go to ground or the virtual ground of an operational amplifier. For every millivolt offset between I_{OUT1} or I_{OUT2}, 0.005% linearity error will be introduced.

Note 4: To achieve this low feedthrough in D package, the user must ground the metal lid.