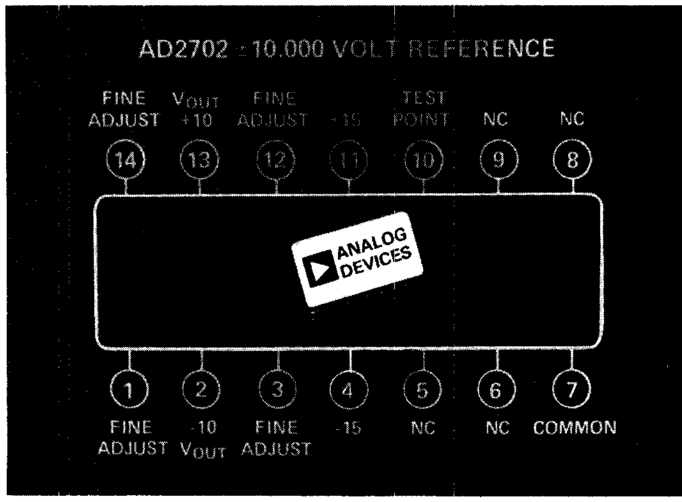
±10 Volt Precision Reference Series

AD2700, AD2701, AD2702

FEATURES
Very High Accuracy: 10.000 Volts ±2.5mV (L and U)
Low Temperature Coefficient: 3ppm/°C
Performance Guaranteed -55°C to +125°C
10mA Output Current Capability
Low Noise
Short Circuit Protected



PRODUCT DESCRIPTION

The AD2700 family of precision 10 volt references offer the user excellent accuracy and stability at a moderate price by combining the recognized advantages of thin film technology and active laser trimming. The low temperature drift (3ppm/°C) achieved with these technologies can be matched only by the use of ovens, chip heaters for temperature regulation, or with hand selected components and manual trimming. In addition, temperature-regulated devices are guaranteed only up to +85°C operation, whereas the U- and S-grade devices in the AD2700 family are guaranteed to +125°C. The AD2700U and AD2700S series are also available with full screening to MIL-STD-883A, Class B.

The AD2700 is a +10 volt reference which is designed to interface with high accuracy bipolar D/A converters of 10 and 12 bit resolution. The 10mA output drive capability also makes the AD2700 ideal for use as a general positive system reference.

The AD2701 is a negative 10 volt reference especially designed to interface with CMOS D/A and A/D converters, as shown in the applications. For systems requiring a dual tracking reference, the AD2702 offers both positive and negative precision 10 volt outputs in a single package.

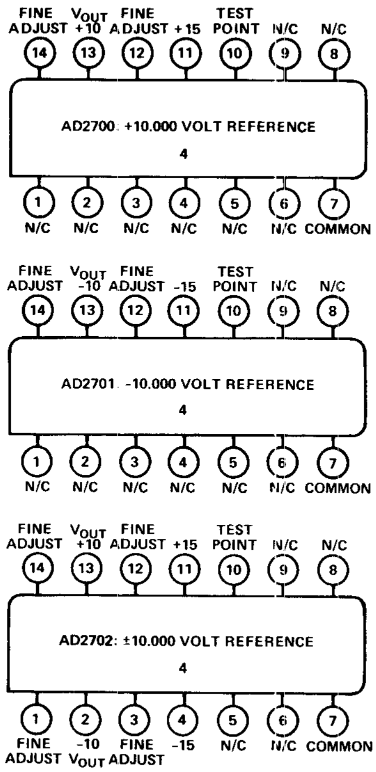
All three devices are offered in "J" and "L" grades for operation from -25°C to +85°C and "S" and "U" grades for the -55°C to +125°C temperature range. All units are packaged in a 14-pin dual-in-line welded metal package which offers excellent reliability, hermeticity, as well as EMI/RFI shielding.

Model	Output
AD2700	+10.000V
AD2701	-10.000V
AD2702	±10.000V

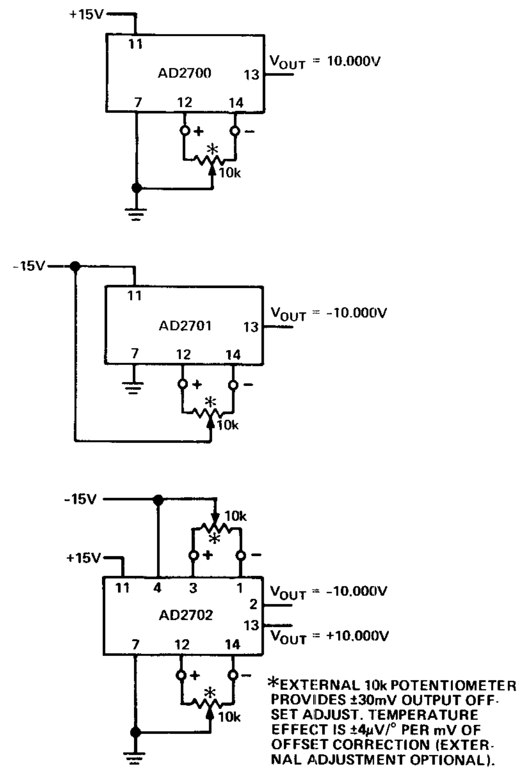
SPECIFICATIONS (maximum or minimum @ E_{in} -15V @ +25°C, R_L = 2kΩ unless otherwise noted)

MODEL	J	L	S	U
ABSOLUTE MAX RATINGS				
Input Voltage (for applicable supply)	±20V	*	*	*
Power Dissapation @ +25°C – AD2700, 01	300mW	*	*	*
– AD2702	450mW	*	*	*
Operating Temperature Range	-25°C to +85°C	*	-55°C to +125°C	***
Storage Temperature Range	-65°C to +150°C	*	*	*
Lead Temperature (soldering, 10s)	+300°C	*	*	*
Short Circuit Protection (to GND)	Continuous	*	*	*
OUTPUT VOLTAGE				
AD2700	10.000V ±0.005V	±0.0025V	*	**
AD2701	-10.000V ±0.005V	±0.0025V	*	**
AD2702	±10.000V ±0.005V	±0.0025V	*	**
OUTPUT CURRENT – @ +25°C	±10mA	*	*	*
(V_{IN} = ±13 to ±18V) over op. range	±5mA	+5mA, -2mA	**	**
OUTPUT VOLTAGE CHANGE[1] – AD2700, 01	10ppm/°C	3ppm/°C	**	**
T_{min} to T_{max} AD2702	10ppm/°C	5ppm/°C	**	3ppm/°C
LINE REGULATION				
V_{IN} = ±13 to ±18V	100μV/V	*	*	*
LOAD REGULATION				
0 to ±10mA	50μV/mA	*	*	*
OUTPUT RESISTANCE	0.05Ω	*	*	*
INPUT VOLTAGE, OPERATING	±13V to ±18V	*	*	*
QUIESCENT CURRENT – AD2700, 01	±14mA	*	*	*
– AD2702	+17mA, -3mA	*	*	*
NOISE				
(0.1 to 10Hz)	50μV p-p typ	*	*	*
LONG TERM STABILITY (@ +55°C)	100ppm/1000 Hrs. typ	*	*	*
OFFSET ADJUST RANGE				
(See Diagrams)	±20mV (min)	*	*	*
OFFSET ADJUST TEMP DRIFT EFFECT	±4μV/°C per mV of Adjust typ	*	*	*

*Same as "J" grade performance.
**Same as "L" grade performance.
***Same as "S" grade performance.
[1] Output voltage change as a function of temperature is determined using the box method. Each unit is tested at -55, -25, +25, +85, +125°C. All readings must fall within the rectangular area bounded by the minimum and maximum temperature and whose diagonal has a slope equal to the stated Drift in ppm/°C: (V_{OUT} max – V_{OUT} min) ÷ (Operating temp. range).
Specifications subject to change without notice.



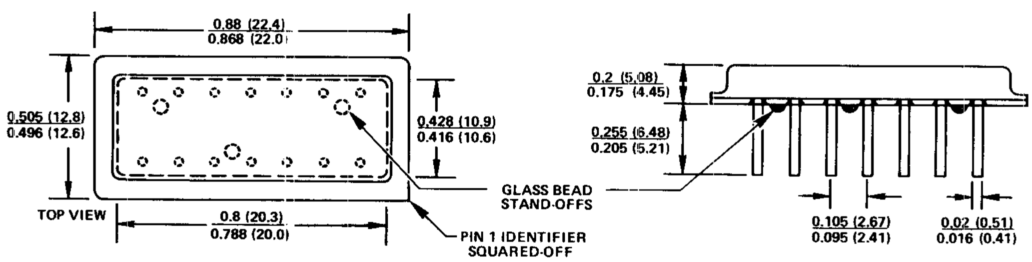
Pin Designations



Fine Trim Connections

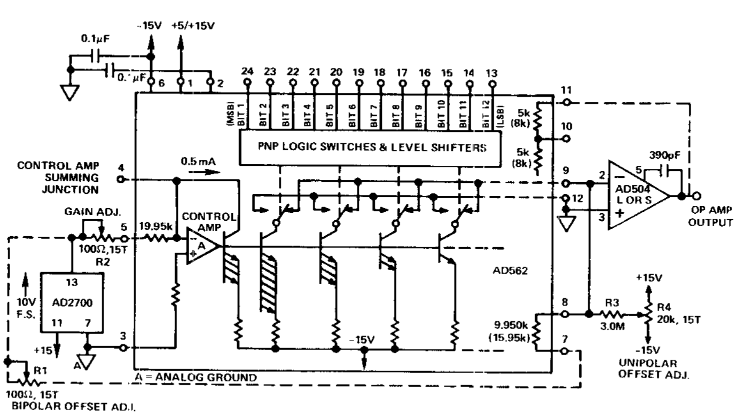
PACKAGE DIMENSIONS

Dimensions shown in inches and (mm).



Hermetically sealed 14 Pin Dual-In-Line (Fine & Gross leak tested per MIL-STD-883A, Method 1014)
Pin 7 is electrically connected to the case. Case has metal bottom surface.

14-Pin Dual-In-Line

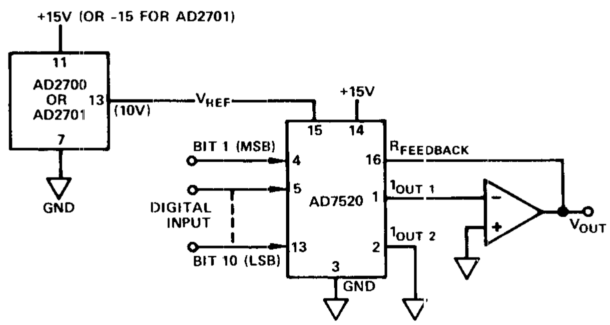


SEE AD562 DATA SHEET FOR ADDITIONAL APPLICATION INFORMATION

Using AD2700 Reference With the AD562 – 12 Bit D/A Converter

USING AD2700 REFERENCE WITH THE AD7520 AND AN IC AMPLIFIER TO BUILD A DAC

The AD2700 series is ideal for use with the AD7520 series of CMOS D/A converters. A CMOS converter in a unipolar application as shown below performs an inversion of the voltage reference input. Thus, use of the +10 volt AD2700 reference will result in a 0 to −10 volt output range. Alternatively, using the −10 volt AD2701 will result in a 0 to +10 volt range. Two operational amplifiers are used to give a bipolar output range of −10 volt to +10 volt, as shown in the lower figure. Either the AD2700 or AD2701 can be used, depending on the transfer code characteristic desired. For more detailed applications information, refer to the AD7520 data sheet.

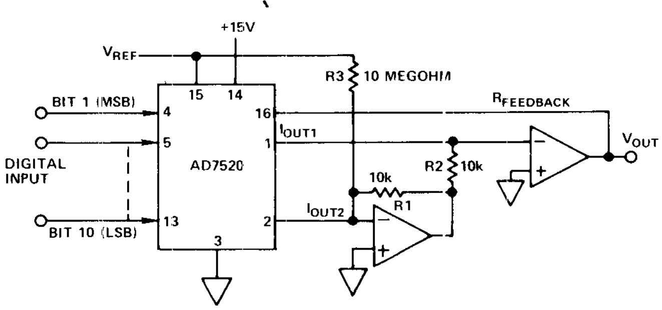


Unipolar Binary Operation

DIGITAL INPUT	ANALOG OUTPUT
1 1 1 1 1 1 1 1 1 1	$-V_{REF}\ (1 - 2^{-10})$
1 0 0 0 0 0 0 0 0 1	$-V_{REF}\ (1/2 + 2^{-10})$
1 0 0 0 0 0 0 0 0 0	$\frac{-V_{REF}}{2}$
0 1 1 1 1 1 1 1 1 1	$-V_{REF}\ (1/2 - 2^{-10})$
0 0 0 0 0 0 0 0 0 1	$-V_{REF}\ (2^{-10})$
0 0 0 0 0 0 0 0 0 0	0

NOTE: 1 LSB = $2^{-10}\ V_{REF}$

Table 1. Code Table – Unipolar Binary Operation



Bipolar Operation (4-Quadrant Multiplication)

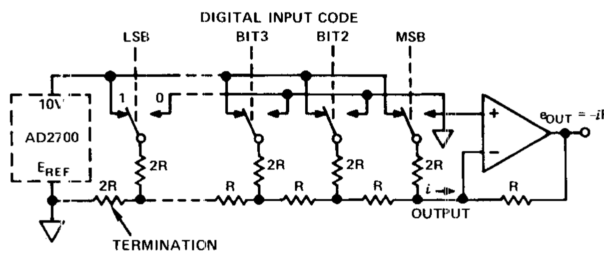
DIGITAL INPUT	ANALOG OUTPUT
1 1 1 1 1 1 1 1 1 1	$-V_{REF}\ (1 - 2^{-9})$
1 0 0 0 0 0 0 0 0 1	$-V_{REF}\ (2^{-9})$
1 0 0 0 0 0 0 0 0 0	0
0 1 1 1 1 1 1 1 1 1	$V_{REF}\ (2^{-9})$
0 0 0 0 0 0 0 0 0 1	$V_{REF}\ (1 - 2^{-9})$
0 0 0 0 0 0 0 0 0 0	V_{REF}

NOTE: 1 LSB = $2^{-9}\ V_{REF}$

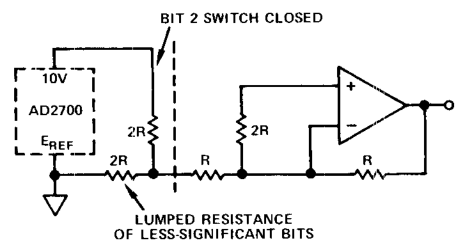
Table 2. Code Table – Bipolar (Offset Binary) Operation

USING THE AD2700 VOLTAGE REFERENCE WITH D/A CONVERTER

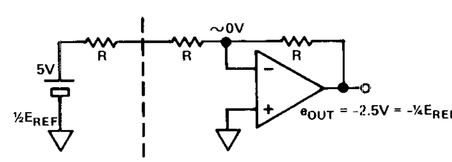
An AD2700 Voltage Reference can be used with an inverting operational amplifier and an R-2R ladder network. If all bits but the MSB are off (i.e., grounded), the output voltage is $(-R/2R)E_{REF}$. If all bits but Bit 2 are off, it can be shown that the output voltage is $\frac{1}{2}(-R/2R)E_{REF} = \frac{1}{4}E_{REF}$: The lumped resistance of all the less-significant-bit circuitry (to the left of Bit 2) is 2R; the Thevenin equivalent looking back from the MSB towards Bit 2 is the generator, $E_{REF}/2$, and the series resistance 2R; since the grounded MSB series resistance, 2R, has virtually no influence – because the amplifier summing point is at virtual ground – the output voltage is therefore $-E_{REF}/4$. The same line of thinking can be employed to show that the nth bit produces an increment of output equal to $2^{-n}\ E_{REF}$.



a. Basic Circuit



b. Example: Contribution of Bit 2; All Other Bits "0"



c. Simplified Equivalent of Circuit (b.)