

FEATURES

Four Programmable Output Voltages:

10.000 V, 7.500 V, 5.000 V, 2.500 V

Laser-Trimmed to High Accuracies

No External Components Required

Trimmed Temperature Coefficient:

5 ppm/°C Max, 0°C to 70°C (AD584L)

15 ppm/°C Max, -55°C to +125°C (AD584T)

Zero Output Strobe Terminal Provided

Two Terminal Negative Reference

Capability (5 V and above)

Output Sources or Sinks Current

Low Quiescent Current: 1.0 mA Max

10 mA Current Output Capability

MIL-STD-883 Compliant Versions Available

GENERAL DESCRIPTION

The AD584 is an eight-terminal precision voltage reference offering pin-programmable selection of four popular output voltages: 10.000 V, 7.500 V, 5.000 V and 2.500 V. Other output voltages, above, below or between the four standard outputs, are available by the addition of external resistors. Input voltage may vary between 4.5 V and 30 V.

Laser Wafer Trimming (LWT) is used to adjust the pin-programmable output levels and temperature coefficients, resulting in the most flexible high precision voltage reference available in monolithic form.

In addition to the programmable output voltages, the AD584 offers a unique strobe terminal which permits the device to be turned on or off. When the AD584 is used as a power supply reference, the supply can be switched off with a single, low-power signal. In the "off" state the current drain by the AD584 is reduced to about 100 μ A. In the "on" state the total supply current is typically 750 μ A including the output buffer amplifier.

The AD584 is recommended for use as a reference for 8-, 10-, or 12-bit D/A converters which require an external precision reference. The device is also ideal for all types of A/D converters of up to 14-bit accuracy, either successive approximation or integrating designs, and in general can offer better performance than that provided by standard self-contained references.

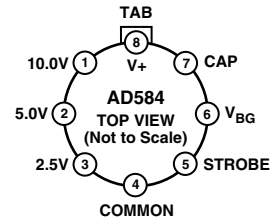
The AD584J, K, and L are specified for operation from 0°C to 70°C; the AD584S and T are specified for the -55°C to +125°C range. All grades are packaged in a hermetically sealed eight-terminal TO-99 metal can; the AD584 J and K are also available in an 8-lead plastic DIP.

*Protected by U.S. Patent No. 3,887,863; RE 30,586.

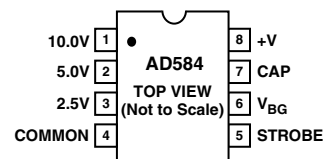
Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices.

PIN CONFIGURATIONS

8-Lead TO-99



8-Lead DIP



PRODUCT HIGHLIGHTS

1. The flexibility of the AD584 eliminates the need to design-in and inventory several different voltage references. Further more one AD584 can serve as several references simultaneously when buffered properly.
2. Laser trimming of both initial accuracy and temperature coefficient results in very low errors over temperature without the use of external components. The AD584LH has a maximum deviation from 10.000 V of ± 7.25 mV from 0°C to 70°C.
3. The AD584 can be operated in a two-terminal "Zener" mode at 5 V output and above. By connecting the input and the output, the AD584 can be used in this "Zener" configuration as a negative reference.
4. The output of the AD584 is configured to sink or source currents. This means that small reverse currents can be tolerated in circuits using the AD584 without damage to the reference and without disturbing the output voltage (10 V, 7.5 V, and 5 V outputs).
5. The AD584 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD584/883B data sheet for detailed specifications.

AD584—SPECIFICATIONS (@ $V_{IN} = 15\text{ V}$ and 25°C unless otherwise noted.)

Model	AD584J			AD584K			AD584L			Unit	
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
OUTPUT VOLTAGE TOLERANCE Maximum Error ¹ for Nominal Outputs of:											
10.000 V			±30			±10			±5	mV	
7.500 V			±20			±8			±4	mV	
5.000 V			±15			±6			±3	mV	
2.500 V			±7.5			±3.5			±2.5	mV	
OUTPUT VOLTAGE CHANGE Maximum Deviation from 25°C Value, T_{MIN} to T_{MAX} ²											
10.000 V, 7.500 V, 5.000 V Outputs			30			15			5	ppm/ $^\circ\text{C}$	
2.500 V Output			30			15			10	ppm/ $^\circ\text{C}$	
Differential Temperature Coefficients Between Outputs											
			5			3			3	ppm/ $^\circ\text{C}$	
QUIESCENT CURRENT Temperature Variation											
			0.75	1.0		0.75	1.0		0.75	1.0	mA
			1.5			1.5			1.5		$\mu\text{A}/^\circ\text{C}$
TURN-ON SETTLING TIME TO 0.1%											
			200			200			200		μs
NOISE (0.1 Hz to 10 Hz)											
			50			50			50		$\mu\text{V p-p}$
LONG-TERM STABILITY											
			25			25			25		ppm/1000 Hrs
SHORT-CIRCUIT CURRENT											
			30			30			30		mA
LINE REGULATION (No Load) $15\text{ V} \leq V_{IN} \leq 30\text{ V}$ $(V_{OUT} 2.5\text{ V}) \leq V_{IN} \leq 15\text{ V}$											
						0.002			0.002		%/V
						0.005			0.005		%/V
LOAD REGULATION $0 \leq I_{OUT} \leq 5\text{ mA}$, All Outputs											
			20	50		20	50		20	50	ppm/mA
OUTPUT CURRENT $V_{IN} \geq V_{OUT} 2.5\text{ V}$ Source @ 25°C Source T_{MIN} to T_{MAX} Sink T_{MIN} to T_{MAX}											
			10			10			10		mA
			5			5			5		mA
			5			5			5		mA
TEMPERATURE RANGE Operating Storage											
			0	70		0	70		0	70	$^\circ\text{C}$
			-65	+175		-65	+175		-65	+175	$^\circ\text{C}$
PACKAGE OPTION ³ TO-99 (H-08A) Plastic (N-8)											
			AD584JH AD584JN			AD584KH AD584KN			AD584LH		

NOTES

¹At Pin 1.

²Calculated as average over the operating temperature range.

³H = Hermetic Metal Can; N = Plastic DIP.

Specifications subject to change without notice.

Specifications shown in **boldface** are tested on all production units at final electrical test. Results from those tests are used to calculate outgoing quality levels. All min and max specifications are guaranteed, although only those shown in boldface are tested on all production units.

Model	AD584S			AD584T			Unit
	Min	Typ	Max	Min	Typ	Max	
OUTPUT VOLTAGE TOLERANCE Maximum Error ¹ for Nominal Outputs of:							
10.000 V			±30			±10	mV
7.500 V			±20			±8	mV
5.000 V			±15			±6	mV
2.500 V			±7.5			±3.5	mV
OUTPUT VOLTAGE CHANGE Maximum Deviation from 25°C Value, T _{MIN} to T _{MAX} ²							
10.000 V, 7.500 V, 5.000 V Outputs			30			15	ppm/°C
2.500 V Output			30			20	ppm/°C
Differential Temperature Coefficients Between Outputs		5			3		ppm/°C
QUIESCENT CURRENT Temperature Variation	0.75	1.0		0.75	1.0		mA μA/°C
TURN-ON SETTLING TIME TO 0.1%	200			200			μs
NOISE (0.1 Hz to 10 Hz)	50			50			μV p-p
LONG-TERM STABILITY	25			25			ppm/1000 Hrs
SHORT-CIRCUIT CURRENT	30			30			mA
LINE REGULATION (No Load) 15 V ≤ V _{IN} ≤ 30 V (V _{OUT} 2.5 V) ≤ V _{IN} ≤ 15 V			0.002 0.005			0.002 0.005	%/V %/V
LOAD REGULATION 0 ≤ I _{OUT} ≤ 5 mA, All Outputs		20	50		20	50	ppm/mA
OUTPUT CURRENT V _{IN} ≥ V _{OUT} 2.5 V Source @ 25°C Source T _{MIN} to T _{MAX} Sink T _{MIN} to T _{MAX}	10 5 5			10 5 5			mA mA mA
TEMPERATURE RANGE Operating Storage	-55 -65		+125 +175	-55 -65		+125 +175	°C °C
PACKAGE OPTION TO-99 (H-08A)		AD584SH			AD584TH		

NOTES

¹At Pin 1.²Calculated as average over the operating temperature range.

Specifications subject to change without notice.

Specifications shown in **boldface** are tested on all production units at final electrical test. Results from those tests are used to calculate outgoing quality levels. All min and max specifications are guaranteed, although only those shown in boldface are tested on all production units.

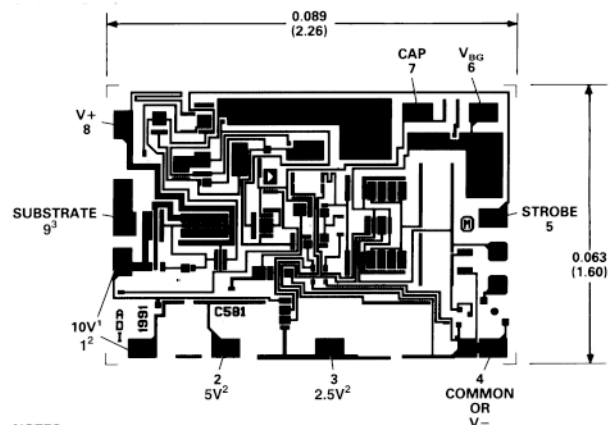
AD584

ABSOLUTE MAXIMUM RATINGS

Input Voltage V_{IN} to Ground	40 V
Power Dissipation @ 25°C	600 mW
Operating Junction Temperature Range	-55°C to +125°C
Lead Temperature (Soldering 10 sec)	300°C
Thermal Resistance	
Junction-to-Ambient (H-08A)	150°C/W

METALIZATION PHOTOGRAPH

Dimensions shown in inches and (mm).



NOTES
¹ BOTH 10V PADS MUST BE CONNECTED TO THE OUTPUT.
² INTERCONNECTIONS REQUIRED; SEE PIN DESIGNATIONS FOR INFORMATION.
³ NOT BROUGHT OUT IN PACKAGE DEVICE.
 PAD NUMBERS CORRESPOND TO PIN NUMBERS FOR THE TO-99, 8-PIN METAL PACKAGE.

ORDERING GUIDE

Model	Ouput Voltage V_O	Initial Accuracy		Temperature Coefficient ppm/°C	Package Description	Package Option	No. of Parts per Package	Temperature Range °C
		mV	%					
AD584L	2.5	±2.5	0.10	10	TO-99	H-8	100	0 to 70
AD584K	2.5	±3.5	0.14	15	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584T	2.5	±3.5	0.14	20	TO-99	H-8	100	-55 to +125
AD584S	2.5	±7.5	0.30	30	TO-99	H-8	100	-55 to +125
AD584J	2.5	±7.5	0.30	30	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584L	5	±3	0.06	5	TO-99	H-8	100	0 to 70
AD584K	5	±6	0.12	15	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584T	5	±6	0.12	15	TO-99	H-8	100	-55 to +125
AD584S	5	±15	0.30	30	TO-99	H-8	48	-55 to +125
AD584J	5	±15	0.30	30	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584L	7.50	±4	0.05	5	TO-99	H-8	100	0 to 70
AD584K	7.50	±8	0.11	15	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584T	7.50	±8	0.11	15	TO-99	H-8	100	-55 to +125
AD584S	7.50	±20	0.27	30	TO-99	H-8	100	-55 to +125
AD584J	7.50	±20	0.27	30	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584L	10.00	±5	0.05	5	TO-99	H-8	100	0 to 70
AD584K	10.00	±10	0.10	15	TO-99, Plastic	H-8, N-8	100, 48	0 to 70
AD584T	10.00	±10	0.10	15	TO-99	H-8	100	-55 to +125
AD584S	10.00	±30	0.30	30	TO-99	H-8	100	-55 to +125
AD584J	10.00	±30	0.30	30	TO-99, Plastic	H-8, N-8	100, 48	0 to 70

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD584 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



APPLYING THE AD584

With power applied to Pins 8 and 4 and all other pins open, the AD584 will produce a buffered nominal 10.0 V output between Pins 1 and 4 (see Figure 1). The stabilized output voltage may be reduced to 7.5 V, 5.0 V, or 2.5 V by connecting the programming pins as follows:

Output Voltage	Pin Programming
7.5 V	Join the 2.5 V and 5.0 V pins (2) and (3).
5.0 V	Connect the 5.0 V pin (2) to the output pin (1).
2.5 V	Connect the 2.5 V pin (3) to the output pin (1).

The options shown above are available without the use of any additional components. Multiple outputs using only one AD584, are also possible by simply buffering each voltage programming pin with a unity-gain noninverting op amp.

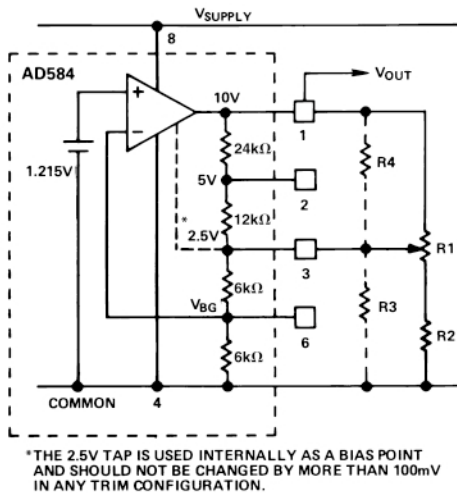


Figure 1. Variable Output Options

The AD584 can also be programmed over a wide range of output voltages, including voltages greater than 10 V, by the addition of one or more external resistors. Figure 1 illustrates the general adjustment procedure, with approximate values given for the internal resistors of the AD584. The AD584 may be modeled as an op amp with a noninverting feedback connection, driven by a high stability 1.215 V bandgap reference (see Figure 3 for schematic).

When the feedback ratio is adjusted with external resistors, the output amplifier can be made to multiply the reference voltage by almost any convenient amount, making popular outputs of 10.24 V, 5.12 V, 2.56 V, or 6.3 V easy to obtain. The most general adjustment (which gives the greatest range and poorest resolution) uses R1 and R2 alone (see Figure 1). As R1 is adjusted to its upper limit the 2.5 V Pin 3 will be connected to the output, which will reduce to 2.5 V. As R1 is adjusted to its lower limit, the output voltage will rise to a value limited by R2. For example, if R2 is about 6 kΩ,

the upper limit of the output range will be about 20 V even for large values of R1. R2 should not be omitted; its value should be chosen to limit the output to a value which can be tolerated by the load circuits. If R2 is zero, adjusting R1 to its lower limit will result in a loss of control over the output voltage. If precision voltages are required to be set at levels other than the standard outputs, the 20% absolute tolerance in the internal resistor ladder must be accounted for.

Alternatively, the output voltage can be raised by loading the 2.5 V tap with R3 alone. The output voltage can be lowered by connecting R4 alone. Either of these resistors can be a fixed resistor selected by test or an adjustable resistor. In all cases the resistors should have a low temperature coefficient to match the AD584 internal resistors, which have a negative TC less than 60 ppm/°C. If both R3 and R4 are used, these resistors should have matched temperature coefficients.

When only small adjustments or trims are required, the circuit of Figure 2 offers better resolution over a limited trim range. The circuit can be programmed to 5.0 V, 7.5 V, or 10 V and adjusted by means of R1 over a range of about ± 200 mV. To trim the 2.5 V output option, R2 (Figure 2) can be reconnected to the bandgap reference (Pin 6). In this configuration, the adjustment should be limited to ± 100 mV in order to avoid affecting the performance of the AD584.

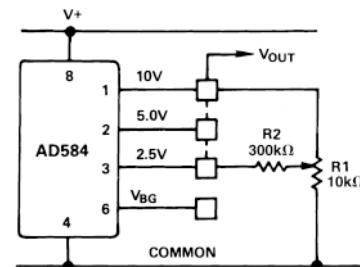


Figure 2. Output Trimming

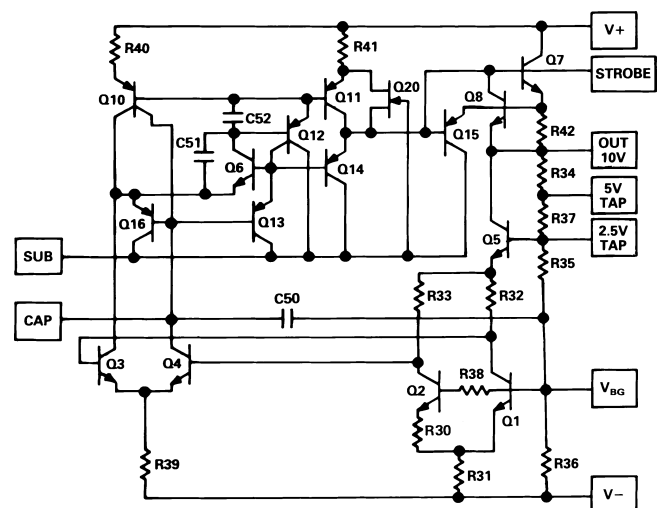
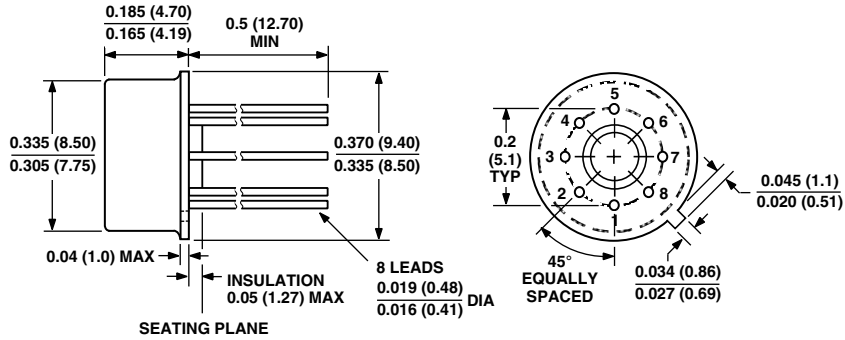


Figure 3. Schematic Diagram

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

**TO-99 Package
(H-8)**



**Plastic DIP Package
(N-8)**

