

### FEATURES

**Low quiescent current: 250  $\mu$ A max**

**Laser trimmed to high accuracy:  
2.5 V  $\pm$  5 mV max (AN, AR grades)**

**Trimmed temperature coefficient:  
20 ppm/ $^{\circ}$ C Max (AN, AR grades)**

**Low noise: 8  $\mu$ V p-p from 0.1 Hz to 10 Hz**

**250 nV/ $\sqrt{\text{Hz}}$  wideband**

**Temperature output pin (N, R packages)**

**Available in three package styles:**

**8-Lead PDIP, 8-lead SOIC, and 3-pin TO-92**

### GENERAL DESCRIPTION

The AD680<sup>1</sup> is a band gap voltage reference that provides a fixed 2.5 V output from inputs between 4.5 V and 36 V. The architecture of the AD680 enables the reference to be operated at a very low quiescent current while still realizing excellent dc characteristics and noise performance. Trimming of the high stability thin-film resistors is performed for initial accuracy and temperature coefficient, resulting in low errors over temperature.

The precision dc characteristics of the AD680 make it ideal for use as a reference for DACs that require an external precision reference. The device is also ideal for ADCs and, in general, can offer better performance than the standard on-chip references. Based upon its low quiescent current, which rivals that of many incomplete 2-terminal references, the AD680 is recommended for low power applications, such as hand-held battery equipment.

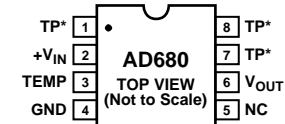
A temperature output pin is provided on the 8-lead package versions of the AD680. The temperature output pin provides an output voltage that varies linearly with temperature and allows the AD680 to be configured as a temperature transducer while providing a stable 2.5 V output.

The AD680 is available in five grades. The AD680AN is specified for operation from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , while the AD680JN is specified for  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  operation. Both the AD680AN and AD680JN are available in an 8-lead PDIP packages. The AD680AR is specified for operation from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , while the AD680JR is specified for  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  operation. Both are available in an 8-lead SOIC package. The AD680JT is specified for  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  operation and is available in a 3-pin TO-92 package.

### Rev. G

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### CONNECTION DIAGRAMS

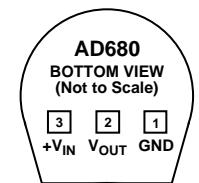


NC = NO CONNECT

\*TP DENOTES FACTORY TEST POINT. NO CONNECTIONS SHOULD BE MADE TO THESE PINS.

00813-003

Figure 1. 8-Lead PDIP and SOIC Pin Configuration



00813-004

Figure 2. Connection Diagram

### PRODUCT HIGHLIGHTS

1. The AD680 band gap reference operates on a very low quiescent current which rivals that of many 2-terminal references. This makes the complete, higher accuracy AD680 ideal for use in power sensitive applications.
2. Laser trimming of both initial accuracy and temperature coefficients results in low errors over temperature without the use of external components. The AD680AN and AD680AR have a maximum variation of 6.25 mV between  $-40^{\circ}\text{C}$  and  $+85^{\circ}\text{C}$ .
3. The AD680 noise is low, typically 8  $\mu$ V p-p from 0.1 Hz to 10 Hz. Spectral density is also low, typically 250 nV/ $\sqrt{\text{Hz}}$ .
4. The temperature output pin on the 8-lead package versions enables the AD680 to be configured as a temperature transducer.
5. PDIP packaging provides machine insertability, while SOIC packaging provides surface-mount capability. TO-92 packaging offers a cost-effective alternative to 2-terminal references, offering a complete solution in the same package in which 2-terminal references are usually found.

<sup>1</sup> Protected by U.S. Patent Nos. 4,902,959; 4,250,445; and 4,857,862.

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**REVISION HISTORY****12/04— Rev. F to Rev. G**

Updated Format .....	Universal
Changes to ORDERING GUIDE .....	11

**5/04—Rev. E to Rev. F**

Changes to ORDERING GUIDE .....	3
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**5/03—Rev. D to Rev. E**

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Added ESD Caution .....	3
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**7/01—Rev. C to Rev. D**

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## SPECIFICATIONS

$T_A = 25^\circ\text{C}$ ,  $V_{IN} = 5\text{ V}$ , unless otherwise noted.

Table 1.

Parameter	AD680AN/AD680AR			AD680JN/AD680JR			AD680JT		Unit	
	Typ	Max	Min	Typ	Max	Min	Typ	Max		
OUTPUT VOLTAGE										
Output Voltage, $V_o$	2.495	2.500	2.505	2.490	2.500	2.510	2.490	2.500	2.510	V
Initial Accuracy, $V_{OERR}$	-5		+5	-10		+10	-10		+10	mV
	-0.20		+0.20	-0.40		+0.40	-0.40		+0.40	%
OUTPUT VOLTAGE DRIFT <sup>1</sup>										
$0^\circ\text{C}$ to $70^\circ\text{C}$		10			10	25		10	30	ppm/ $^\circ\text{C}$
$-40^\circ\text{C}$ to $+85^\circ\text{C}$			20		25			25		ppm/ $^\circ\text{C}$
LINE REGULATION										
$4.5\text{ V} \leq +V_{IN} \leq 15\text{ V}$			40			40			40	$\mu\text{V}/\text{V}$
(@ $T_{MIN}$ to $T_{MAX}$ )			40			40			40	$\mu\text{V}/\text{V}$
$15\text{ V} \leq +V_{IN} \leq 36\text{ V}$			40			40			40	$\mu\text{V}/\text{V}$
(@ $T_{MIN}$ to $T_{MAX}$ )			40			40			40	$\mu\text{V}/\text{V}$
LOAD REGULATION										
$0 < I_{OUT} < 10\text{ mA}$		80	100		80	100		80	100	$\mu\text{V}/\text{mA}$
(@ $T_{MIN}$ to $T_{MAX}$ )		80	100		80	100		80	100	$\mu\text{V}/\text{mA}$
QUIESCENT CURRENT		195	<b>250</b>		195	<b>250</b>		195	<b>250</b>	$\mu\text{A}$
(@ $T_{MIN}$ to $T_{MAX}$ )			280			280			280	$\mu\text{A}$
POWER DISSIPATION		1	<b>1.25</b>		1	<b>1.25</b>		1	<b>1.25</b>	mW
OUTPUT NOISE										
$0.1\text{ Hz}$ to $10\text{ Hz}$		8	10		8	10		8	10	$\mu\text{V p-p}$
Spectral Density, $100\text{ Hz}$		250			250			250		$\text{nV}/\sqrt{\text{Hz}}$
CAPACITIVE LOAD			50			50			50	nF
LONG-TERM STABILITY		25			25			25		ppm/1000 hr
SHORT-CIRCUIT CURRENT TO GROUND		25	50		25	50		25	50	mA
TEMPERATURE PIN										
Voltage Output @ $25^\circ\text{C}$	540	596	660	540	596	660				mV
Temperature Sensitivity		2			2					mV/ $^\circ\text{C}$
Output Current	-5		+5	-5		+5				$\mu\text{A}$
Output Resistance		12			12					k $\Omega$
TEMPERATURE RANGE										
Specified Performance	-40		+85	0		70	0		70	$^\circ\text{C}$
Operating Performance <sup>2</sup>	-40		+85	-40		+85	-40		+85	$^\circ\text{C}$

<sup>1</sup> Maximum output voltage drift is guaranteed for all packages.

<sup>2</sup> The operating temperature range is defined as the temperature extremes at which the device will still function. Parts may deviate from their specified performance outside their specified temperature range.

Specifications in **boldface** are tested on all production units at final electrical test. Results from these tests are used to calculate outgoing quality levels. All minimum and maximum specifications are guaranteed.

## ABSOLUTE MAXIMUM RATINGS

**Table 2.**

<b>Parameter</b>	<b>Rating</b>
V <sub>IN</sub> to Ground	36 V
Power Dissipation (25°C)	500 mW
Storage Temperature	–65°C to +125°C
Lead Temperature (Soldering, 10 s)	300°C
Package Thermal Resistance $\theta_{JA}$ (All Packages)	120°C/W
Output Protection: Output safe for indefinite short to ground and momentary short to V <sub>IN</sub> .	

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### ESD 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 this product 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.



# AD680

## ORDERING GUIDE

Model	Output Voltage V <sub>o</sub> (V)	Initial Accuracy		Temperature Coefficient (ppm/°C)	Package Description	Package Option	Parts per Reel	Temperature Range (°C)
		(mV)	(%)					
AD680AR	2.5	5	0.20	20	SOIC	R-8		-40 to +85
AD680AR-REEL	2.5	5	0.20	20	SOIC	R-8	2,500	-40 to +85
AD680AR-REEL7	2.5	5	0.20	20	SOIC	R-8	750	-40 to +85
AD680ARZ <sup>1</sup>	2.5	5	0.20	20	SOIC	R-8		-40 to +85
AD680ARZ-REEL7 <sup>1</sup>	2.5	5	0.20	20	SOIC	R-8	750	-40 to +85
AD680JR	2.5	10	0.40	25	SOIC	R-8		0 to 70
AD680JR-REEL	2.5	10	0.40	25	SOIC	R-8	2,500	0 to 70
AD680JRZ <sup>1</sup>	2.5	10	0.40	25	SOIC	R-8		0 to 70
AD680JRZ-REEL7 <sup>1</sup>	2.5	10	0.40	25	SOIC	R-8	750	0 to 70
AD680AN	2.5	5	0.20	20	PDIP	N-8		-40 to +85
AD680JN	2.5	10	0.40	25	PDIP	N-8		0 to 70
AD680JT	2.5	10	0.40	30	TO-92	T-3		0 to 70

<sup>1</sup> Z = Pb-free part.