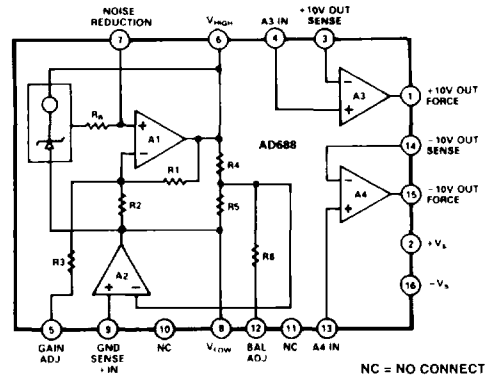


### FEATURES

- ±10 V Tracking Outputs
- Kelvin Connections
- Low Tracking Error – 1.5 mV
- Low Initial Error – 2.0 mV
- Low Drift – 1.5 ppm/°C
- Low Noise – 6 μV p-p
- Flexible Output Force and Sense Terminals
- High Impedance Ground Sense
- Machine Insertable DIP Packaging
- MIL-STD-883 Compliant Versions Available

### FUNCTIONAL BLOCK DIAGRAM



NC = NO CONNECT

### PRODUCT DESCRIPTION

The AD688 is a high precision ±10 V tracking reference. Low tracking error, low initial error and low temperature drift give the AD688 reference absolute ±10 V accuracy performance previously unavailable in monolithic form. The AD688 uses a proprietary ion-implanted buried Zener diode, and laser-wafer-drift-trimming of high stability thin-film resistors to provide outstanding performance at low cost.

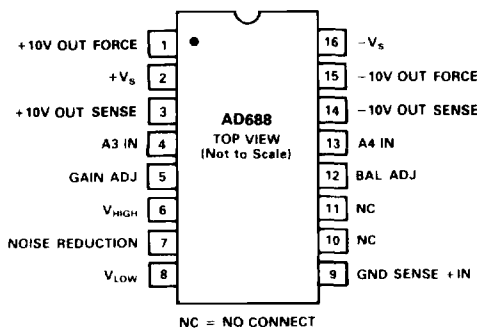
The AD688 includes the basic reference cell and three additional amplifiers. The amplifiers are laser-trimmed for low offset and low drift and maintain the accuracy of the reference. The amplifiers are configured to allow Kelvin connections to the load and/or boosters for driving long lines or high current loads, delivering the full accuracy of the AD688 where it is required in the application circuit.

The low initial error allows the AD688 to be used as a system reference in precision measurement applications requiring 12-bit absolute accuracy. In such systems, the AD688 can provide a known voltage for system calibration and the cost of periodic recalibration can therefore be eliminated. Furthermore, the mechanical instability of a trimming potentiometer and the potential for improper calibration can be eliminated by using the AD688 and calibration software.

The AD688 is available in three versions. The AD688AQ and BQ grades are packaged in 16-pin cerdip (0.3") packages and are specified for operation from -40°C to +85°C. The AD688SQ grade is specified for operation from -55°C to +125°C.

\*Covered by Patent Number 4,644,253.

### PIN CONFIGURATION



NC = NO CONNECT

### ORDERING GUIDE

Part Number <sup>1</sup>	Initial Error	Temperature Coefficient	Temperature Range – °C	Package Option <sup>2</sup>
AD688AQ	5 mV	3 ppm/°C	-40 to +85	Q-16
AD688BQ	2 mV	3 ppm/°C	-40 to +85*	Q-16
AD688SQ	5 mV	6 ppm/°C	-55 to +125	Q-16

### NOTES

<sup>1</sup>For details on grade and package offerings screened in accordance with MIL-STD-883, refer to the *Analog Devices Military Products Databook* or current AD688/883B data sheet.

<sup>2</sup>Q = Cerdip. For outline information see Package Information section.

\*Temperature coefficient specified from 0°C to +70°C.

To obtain the most recent version or complete data sheet, call our fax retrieval system at 1-800-446-6212 or visit our World Wide Web site at <http://www.analog.com>.

# AD688—SPECIFICATIONS (typical @ +25°C, +10 V output, $V_S = \pm 15$ V unless otherwise noted<sup>1</sup>)

	AD688AQ/SQ			AD688BQ			Units
	Min	Typ	Max	Min	Typ	Max	
OUTPUT VOLTAGE ERROR +10 V, -10 V Outputs	-5		+5	-2		+2	mV
+10 V TRACKING ERROR	-3		+3	-1.5		+1.5	mV
OUTPUT VOLTAGE DRIFT +10 V, -10 V Outputs							
0°C to +70°C (A, B)		±2		-1.5		+1.5	ppm/°C
-40°C to +85°C (A, B)	-3		+3	-3		+3	ppm/°C
55°C to +125°C (S)	-6		+6				ppm/°C
GAIN ADJ AND BAL ADJ <sup>2</sup>							
Trim Range		+5			+5		mV
Input Resistance		150			150		kΩ
LINE REGULATION $T_{MIN}$ to $T_{MAX}$ <sup>3</sup>	-200		+200	-200		+200	μV/V
LOAD REGULATION $T_{MIN}$ to $T_{MAX}$							
+10 V Output, $0 < I_{OUT} < 10$ mA			±50			±50	μV/mA
-10 V Output, $-10 < I_{OUT} < 0$ mA			±50			±50	μV/mA
SUPPLY CURRENT $T_{MIN}$ to $T_{MAX}$		9	12	9	12		mA
Power Dissipation		270	360	270	360		mW
OUTPUT NOISE (ANY OUTPUT) 0.1 Hz to 10 Hz		6		6			μV p-p
Spectral Density, 100 Hz		140		140			nV/√Hz
LONG TERM STABILITY ( $@ +25^\circ\text{C}$ )		15		15			ppm/1000 hours
BUFFER AMPLIFIERS							
Offset Voltage		100		100			μV
Offset Voltage Drift		1		1			μV/°C
Bias Current		20		20			nA
Open Loop Gain		110		110			dB
Output Current A3, A4	-10		+10	-10		+10	mA
Common Mode Rejection (A3, A4) $V_{CM} = 1$ V p-p		100		100			dB
Short-Circuit Current		50		50			mA
TEMPERATURE RANGE Specified Performance							
A, B Grades	40		+85	40		+85	°C
S Grade	55		+125				°C

## NOTES

<sup>1</sup>See Figure 2a for output configuration. Specifications tested using +10 V output unless otherwise indicated.

<sup>2</sup>Gain and balance adjustments guaranteed capable of trimming output voltage error and symmetry error to zero.

<sup>3</sup>Test Condition:  $+V_S = +18$  V,  $-V_S = -18$  V;  $+V_S = +13.5$  V,  $-V_S = -13.5$  V.

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.

Specifications subject to change without notice.

## ABSOLUTE MAXIMUM RATINGS\*

$+V_S$  to  $-V_S$  ..... 36 V

Power Dissipation (+25°C) .....

    Q Package ..... 600 mW

Storage Temperature ..... -65°C to +150°C

Lead Temperature (Soldering, 10 Seconds) ..... +300°C

Package Thermal Resistance .....

    Q ( $\theta_{JA}/\theta_{JC}$ ) ..... 120/35 C/W

Output Protection: All outputs safe if shorted to ground

\*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 sections of this specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.