

FEATURES

Low Drift: 1.5 ppm/°C

Low Initial Error: 1 mV

Pin Programmable Output:

+10 V, +5 V, +65 V Tracking, -5 V, -10 V

Flexible Output Force and Sense Terminals

High Impedance Ground Sense

Machine Insertable DIP Packaging

MIL-STD-883 Compliant Versions Available

GENERAL DESCRIPTION

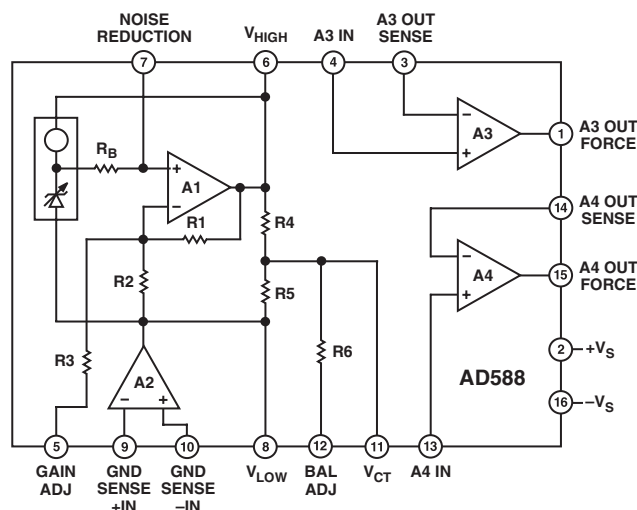
The AD588 represents a major advance in the state-of-the-art in monolithic voltage references. Low initial error and low temperature drift give the AD588 absolute accuracy performance previously not available in monolithic form. The AD588 uses a proprietary ion-implanted buried Zener diode, and laser-wafer-drift trimming of high stability thin-film resistors to provide outstanding performance at low cost.

The AD588 includes the basic reference cell and three additional amplifiers that provide pin programmable output ranges. The amplifiers are laser-trimmed for low offset and low drift to 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 AD588 where it is required in the application circuit.

The low initial error allows the AD588 to be used as a system reference in precision measurement applications requiring 12-bit absolute accuracy. In such systems, the AD588 can provide a known voltage for system calibration in software, and the low drift allows compensation for the drift of other components in a system. Manual 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 AD588 in conjunction with autocalibration software.

The AD588 is available in four versions. The AD588JQ and AD588KQ and grades are packaged in a 16-lead Cerdip and are specified for 0°C to 70°C operation. AD588AQ and BQ grades are packaged in a 16-lead Cerdip and are specified for the -25°C to +85°C industrial temperature range.

FUNCTIONAL BLOCK DIAGRAM



PRODUCT HIGHLIGHTS

1. The AD588 offers 12-bit absolute accuracy without any user adjustments. Optional fine-trim connections are provided for applications requiring higher precision. The fine trimming does not alter the operating conditions of the Zener or the buffer amplifiers, and thus does not increase the temperature drift.
2. Output noise of the AD588 is very low—typically 6 μ V p-p. A pin is provided for additional noise filtering using an external capacitor.
3. A precision ± 5 V tracking mode with Kelvin output connections is available with no external components. Tracking error is less than 1 mV and a fine-trim is available for applications requiring exact symmetry between the +5 V and -5 V outputs.
4. Pin strapping capability allows configuration of a wide variety of outputs: ± 5 V, +5 V, +10 V, -5 V, and -10 V dual outputs or +5 V, -5 V, +10 V, and -10 V single outputs.

*Protected by Patent Number 4,644,253.

REV. D

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AD588—SPECIFICATIONS (Typical @ 25°C, 10 V output, $V_S = \pm 15$ V, unless otherwise noted.¹)

Parameter	AD588JQ/AQ			AD588BQ/KQ			Unit
	Min	Typ	Max	Min	Typ	Max	
OUTPUT VOLTAGE ERROR							
+10 V, -10 V Outputs			±3	-1		+1	mV
+5 V, -5 V Outputs			±3	-1		+1	mV
±5 V TRACKING MODE							
Symmetry Error			±1.5			±0.75	mV
OUTPUT VOLTAGE DRIFT							
0°C to 70°C (J, K, B)		±2	±3			±1.5	ppm/°C
-25°C to +85°C (A, B)			±3			±3	ppm/°C
GAIN ADJ AND BAL ADJ ²							
Trim Range		±4			±4		mV
Input Resistance		150			150		kΩ
LINE REGULATION							
T_{MIN} to T_{MAX} ³			±200			±200	μV/V
LOAD REGULATION							
T_{MIN} to T_{MAX}							
+10 V Output, 0 mA < I_{OUT} < 10 mA			±50			±50	μV/mA
-10 V Output, -10 mA < I_{OUT} < 0 mA			±50			±50	μV/mA
SUPPLY CURRENT							
T_{MIN} to T_{MAX}		6	10		6	10	mA
Power Dissipation		180	300		180	300	mW
OUTPUT NOISE (Any Output)							
0.1 Hz to 10 Hz		6			6		μV p-p
Spectral Density, 100 Hz		100			100		nV/√Hz
LONG-TERM STABILITY (@ 25°C)		15			15		ppm/1000 hr
BUFFER AMPLIFIERS							
Offset Voltage		100			10		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							
J, K Grades	0		70	0		70	°C
A, B Grades	-25		+85	-25		+85	°C

NOTES

¹ Output	Configuration
+10 V	Figure 2a
-10 V	Figure 2c
+5 V, -5 V, ±5 V	Figure 2b

Specifications tested using +10 V configuration, unless otherwise indicated.

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

³Test Conditions:

+10 V Output	$-V_S = -15$ V, 13.5 V ≤ $+V_S$ ≤ 18 V
-10 V Output	-18 V ≤ $-V_S$ ≤ -13.5 V, $+V_S = 15$ V
±5 V Output	$+V_S = +18$ V, $-V_S = -18$ V
	$+V_S = +10.8$ V, $-V_S = -10.8$ V

For ±10 V output, ± V_S can be as low as ±12 V.

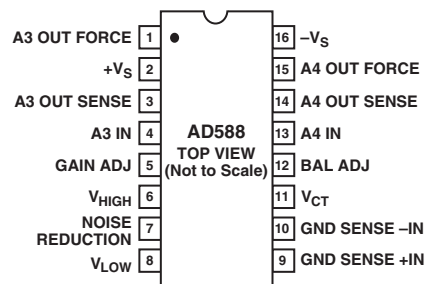
Specifications subject to change without notice.

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.

ABSOLUTE MAXIMUM RATINGS*

$+V_S$ to $-V_S$ 36 V
 Power Dissipation (25°C) 600 mW
 Storage Temperature Range -65°C to +150°C
 Lead Temperature Range (Soldering 10 sec) 300°C
 Package Thermal Resistance (θ_{JA}/θ_{JC}) 90°C/25°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; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

PIN CONFIGURATION**ORDERING GUIDE**

Part Number ¹	Initial Error (mV)	Temperature Coefficient ²	Temperature Range (°C)	Package Option
AD588AQ	3	3 ppm/°C	-25 to +85	CERDIP (Q-16)
AD588BQ	1	1.5 ppm/°C	-25 to +85 ²	CERDIP (Q-16)
AD588JQ	3	3 ppm/°C	0 to 70	CERDIP (Q-16)
AD588KQ	1	1.5 ppm/°C	0 to 70	CERDIP (Q-16)

NOTES

¹For details on grade and package offerings screened in accordance with MIL-STD-883, refer to the Analog Devices Military Products Databook or current AD588/883B.

²Temperature coefficient specified from 0°C to 70°C.

CAUTION

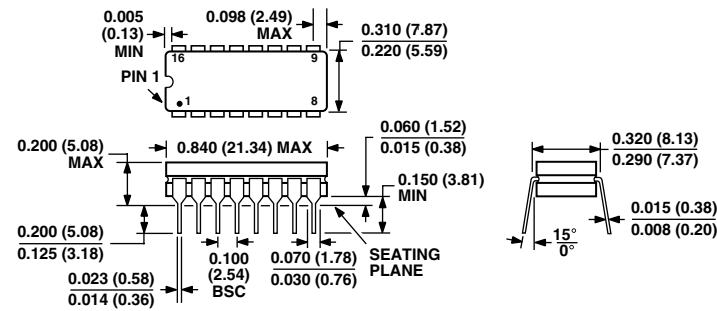
ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD588 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



OUTLINE DIMENSIONS

16-Lead Ceramic DIP-Glass Hermetic Seal Package [CERDIP]
(Q-16)

Dimensions shown in inches and (millimeters)



CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETERS DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Revision History

Location	Page
2/03—Data Sheet changed from REV. C to REV. D.	
Added KQ model and deleted SQ and TQ models	Universal
Changes to GENERAL DESCRIPTION	1
Change to PRODUCT HIGHLIGHTS	1
Changes to SPECIFICATIONS	2
Change to ORDERING GUIDE	3
Updated OUTLINE DIMENSIONS	15
10/02—Data Sheet changed from REV. B to REV. C.	
Changes to GENERAL DESCRIPTION	1
Changes to SPECIFICATIONS	2
Changes to ORDERING GUIDE	3
Changes to TABLE 1	5
Deleted Figure 10c	7
OUTLINE DIMENSIONS updated	15