Low Noise Micropower 2.5 V Precision Voltage Reference

ADR291W

FEATURES

Qualified for automotive applications
Supply range
2.8 V to 15 V
Supply current: 15 μA maximum
Low noise: 8 μV (0.1 Hz to 10 Hz)
High output current: 5 mA
Temperature range: −40°C to +125°C
Pin compatible with REF02/REF19x

APPLICATIONS

Automotive Li-Ion Battery Measurement
Analog-to-digital and digital-to-analog converter reference

CONNECTION DIAGRAM

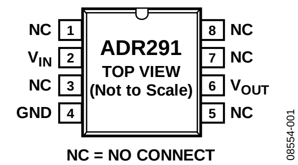

Figure 1. 8-Lead SOIC_N (R-8)

GENERAL DESCRIPTION

The ADR291 is a low noise, micropower precision voltage reference that uses an XFET® reference circuit. The XFET architecture offers significant performance improvements over traditional band gap and buried Zener-based references. Improvements include one quarter of the voltage noise output of band gap references operating at the same current, very low and ultralinear temperature drift, low thermal hysteresis, and excellent long-term stability.

The ADR291 is a series voltage reference providing a stable and accurate output voltage from supplies as low as 2.8 V. The output voltage is 2.5 V.

Quiescent current is only 12 μA, making these devices ideal for battery-powered instrumentation. Output accuracy is ±8.3 mV maximum. Temperature coefficient is 15 ppm/°C maximum.

Line regulation and load regulation are typically 30 ppm/V and 30 ppm/mA, maintaining the overall high performance of the reference. For a device with 5.0 V output, refer to the ADR293 data sheet.

The ADR291 is specified over the automotive temperature range of −40°C to +125°C. The device is available in the 8-lead SOIC package.

Table 1. ADR291 Product Details

Part No.	Output Voltage (V)	Accuracy (±%)	Temperature Coefficient (ppm/°C) Max
ADR291	2.500	0.332	15

Rev. 0

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REVISION HISTORY

3/10—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

V_S = 3.0 V to 15 V, T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
F GRADE						
Output Voltage	V_{OUT}	I_{OUT} = 0 mA, −40°C ≤ T_A ≤ +125°C	2.4917	2.500	2.5083	V
Output Voltage Variation[1]			−0.332		+0.332	%
LINE REGULATION						
F Grade	$\Delta V_{OUT}/\Delta V_{IN}$	I_{OUT} = 0 mA		30	100	ppm/V
LOAD REGULATION						
F Grade	$\Delta V_{OUT}/\Delta I_{LOAD}$	V_S = 5.0 V, I_{OUT} = 0 mA to 5 mA		30	100	ppm/mA
LONG-TERM STABILITY	ΔV_{OUT}	After 1000 hours of operation @ 125°C		50		ppm
NOISE VOLTAGE	e_N	0.1 Hz to 10 Hz		8		μV p-p
WIDEBAND NOISE DENSITY	e_N	At 1 kHz		480		nV/√Hz

[1] Includes output voltage changes due to long-term drift and thermally induced output voltage hysteresis.

V_S = 3.0 V to 15 V, T_A = −25°C to +85°C, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
TEMPERATURE COEFFICIENT						
F Grade				5	15	ppm/°C
LINE REGULATION						
F Grade	$\Delta V_{OUT}/\Delta V_{IN}$	I_{OUT} = 0 mA		35	125	ppm/V
LOAD REGULATION						
F Grade	$\Delta V_{OUT}/\Delta I_{LOAD}$	V_S = 5.0 V, I_{OUT} = 0 mA to 5 mA		20	125	ppm/mA

V_S = 3.0 V to 15 V, T_A = −40°C to +125°C, unless otherwise noted.

Table 4.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
TEMPERATURE COEFFICIENT						
F Grade				5	20	ppm/°C
LINE REGULATION						
F Grade	$\Delta V_{OUT}/\Delta V_{IN}$	I_{OUT} = 0 mA		40	200	ppm/V
LOAD REGULATION						
F Grade	$\Delta V_{OUT}/\Delta I_{LOAD}$	V_S = 5.0 V, I_{OUT} = 0 mA to 5 mA		20	200	ppm/mA
SUPPLY CURRENT	I_S	T_A = 25°C		9	12	μA
		−40°C ≤ T_A ≤ +125°C		12	15	μA
OUTPUT VOLTAGE HYSTERESIS	$V_{OUT-HYS}$	8-lead SOIC		50		ppm

ABSOLUTE MAXIMUM RATINGS

Remove power before inserting or removing units from their sockets.

Table 5.

Parameter	Rating
Supply Voltage	18 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	
R Package	−65°C to +150°C
Operating Temperature Range	
ADR291WFRZ	−40°C to +125°C
Junction Temperature Range	
R Package	−65°C to +125°C
Lead Temperature (Soldering, 60 sec)	300°C

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 section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 6. Package Type

Package Type	θ_{JA}[1]	θ_{JC}	Unit
8-Lead SOIC_N (R)	158	43	°C/W

[1] θ_{JA} is specified for worst-case conditions. For example, θ_{JA} is specified for a device in socket testing. In practice, θ_{JA} is specified for a device soldered in the circuit board.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

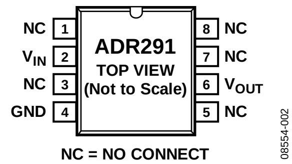

Figure 2. Pin Configuration

Table 7. Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 3, 5, 7, 8	NC	No Connect
2	V_{IN}	Input Voltage
4	GND	Ground
6	V_{OUT}	Output Voltage

TERMINOLOGY

Line Regulation

Line regulation refers to the change in output voltage due to a specified change in input voltage. It includes the effects of self-heating. Line regulation is expressed as percent per volt, parts per million per volt, or microvolts per volt change in input voltage.

Load Regulation

The change in output voltage is due to a specified change in load current and includes the effects of self-heating. Load regulation is expressed in microvolts per milliampere, parts per million per milliampere, or ohms of dc output resistance.

Long-Term Stability

Long-term stability refers to the typical shift of output voltage at 25°C on a sample of parts subjected to a test of 1000 hours at 125°C.

$$\Delta V_{OUT} = V_{OUT}(t_0) - V_{OUT}(t_1)$$

$$\Delta V_{OUT}[\text{ppm}] = \frac{V_{OUT}(t_0) - V_{OUT}(t_1)}{V_{OUT}(t_0)} \times 10^6$$

where:
V_{OUT} (t_0) = V_{OUT} at 25°C at Time 0.
V_{OUT} (t_1) = V_{OUT} at 25°C after 1000 hours of operation at 125°C.

Temperature Coefficient

Temperature coefficient is the change of output voltage over the operating temperature change, normalized by the output voltage at 25°C, expressed in ppm/°C. The equation follows:

$$TCV_O[\text{ppm}/°\text{C}] = \frac{V_{OUT}(T_2) - V_{OUT}(T_1)}{V_{OUT}(25°\text{C}) \times (T_2 - T_1)} \times 10^6$$

where:
V_{OUT} (25°C) = V_{OUT} at 25°C.
V_{OUT} (T_1) = V_{OUT} at Temperature 1.
V_{OUT} (T_2) = V_{OUT} at Temperature 2.

NC = No Connect

There are internal connections at NC pins that are reserved for manufacturing purposes. Users should not connect anything at the NC pins.

Thermally Induced Output Voltage Hysteresis

Thermally induced output voltage hysteresis is defined as the change of output voltage after the device is cycled through temperatures from +25°C to −40°C, then to +85°C, and back to +25°C. This is a typical value from a sample of parts put through such a cycle.

$$V_{OUT-HYS} = V_{OUT}\ (25°\text{C}) - V_{OUT\_TC}$$

$$V_{OUT-HYS}[\text{ppm}] = \frac{V_{OUT}\ (25°C) - V_{OUT\_TC}}{V_{OUT}\ (25°\text{C})} \times 10^6$$

where:
V_{OUT} (25°C) = V_{OUT} at 25°C.
V_{OUT-TC} = V_{OUT} at 25°C after temperature cycle from +25°C to −40°C, then to +85°C, and back to +25°C.

OUTLINE DIMENSIONS

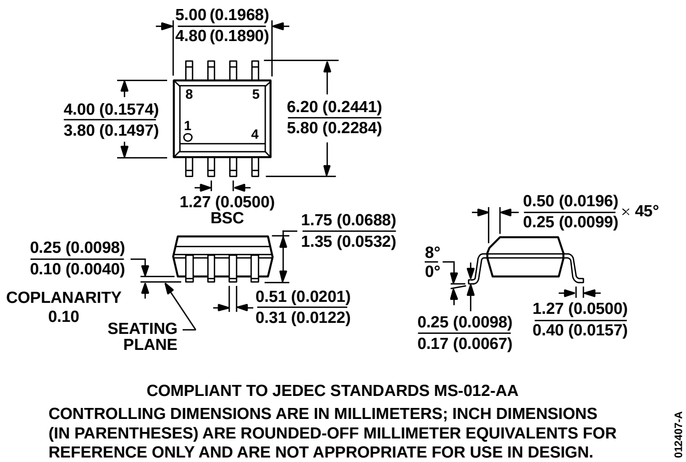

Figure 3. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model[1]	Output Voltage	Initial Accuracy (±%)	Temperature Coefficient Max (ppm/°C)	Temperature Range	Package Description	Package Option	Ordering Quantity
ADR291WFRZ-RL	2.50	0.12	15	−40°C to +125°C	8-Lead SOIC_N	R-8	2,500
ADR291WFRZ-R7	2.50	0.12	15	−40°C to +125°C	8-Lead SOIC_N	R-8	1,000

[1] Z = RoHS Compliant Part.