Low Noise, Micropower 5.0 V Precision Voltage Reference

ADR293-EP

FEATURES

- 6.0 V to 15 V supply range
- Supply current: 15 µA maximum
- Low noise: 15 µV p-p typical (0.1 Hz to 10 Hz)
- High output current: 5 mA
- Pin-compatible with the REF02/REF19x

ENHANCED PRODUCT FEATURES

- Supports defense and aerospace applications (AQEC standard)
- Military temperature range (−55°C to +125°C)
- Controlled manufacturing baseline
- 1 assembly/test site
- 1 fabrication site
- Enhanced product change notification
- Qualification data available on request

APPLICATIONS

- Portable instrumentation
- Precision reference for 5 V systems
- ADC and DAC reference
- Solar-powered applications

PIN CONFIGURATION

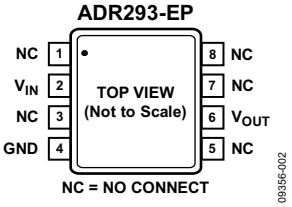

Figure 1. 8-Lead TSSOP (RU-8)

GENERAL DESCRIPTION

The ADR293-EP is a low noise, micropower precision voltage reference that utilizes an XFET® (eXtra implanted junction FET) reference circuit. The XFET architecture offers significant performance improvements over traditional band gap and buried Zener-based references. Improvements include one quarter 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 ADR293-EP is a series voltage reference providing stable and accurate output voltage from a 6.0 V supply. Quiescent current is only 15 µA maximum, making this device ideal for battery powered instrumentation. The temperature coefficient is 30 ppm/°C maximum over the military temperature range, and the initial error is only 0.2% at 25°C. Line regulation and load regulation are typically 70 ppm/V and 30 ppm/mA, respectively, maintaining the reference's overall high performance.

The ADR293-EP is specified over the military temperature range of −55°C to +125°C. This device is available in an 8-lead TSSOP package.

Additional applications information is available in the ADR293 data sheet.

Rev. 0

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REVISION HISTORY

9/10—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

V_S = 6.0 V, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
OUTPUT VOLTAGE	V_{OUT}	I_{OUT} = 0 mA				
T Grade			4.990	5.000	5.010	V
INITIAL ACCURACY		I_{OUT} = 0 mA				
T Grade			−10		+10	mV
					0.20	%
LINE REGULATION	$\Delta V_{OUT}/\Delta V_{IN}$	6.0 V to 15 V, I_{OUT} = 0 mA				
T Grade				40	150	ppm/V
LOAD REGULATION	$\Delta V_{OUT}/\Delta I_{LOAD}$	V_S = 6.0 V, I_{OUT} = 0 mA to 5 mA				
T Grade				30	150	ppm/mA
LONG-TERM STABILITY	ΔV_{OUT}	After 1000 hours of operation @ 125°C		50		ppm
VOLTAGE NOISE	$e_{N\ p\text{-}p}$	f = 0.1 Hz to 10 Hz		15		µV p-p
VOLTAGE NOISE DENSITY	e_N	f = 1 kHz		640		nV/√Hz

V_S = 6.0 V, T_A = −25°C to +85°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
TEMPERATURE COEFFICIENT	TCV_{OUT}	I_{OUT} = 0 mA				
T Grade				10	25	ppm/°C
LINE REGULATION	$\Delta V_{OUT}/\Delta V_{IN}$	6.0 V to 15 V, I_{OUT} = 0 mA				
T Grade				50	200	ppm/V
LOAD REGULATION	$\Delta V_{OUT}/\Delta I_{LOAD}$	V_S = 6.0 V, I_{OUT} = 0 mA to 5 mA				
T Grade				30	200	ppm/mA

V_S = 6.0 V, T_A = −55°C to +125°C, unless otherwise noted.

Table 3.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
TEMPERATURE COEFFICIENT	TCV_{OUT}	I_{OUT} = 0 mA				
T Grade				10	30	ppm/°C
LINE REGULATION	$\Delta V_{OUT}/\Delta V_{IN}$	6.0 V to 15 V, I_{OUT} = 0 mA				
T Grade				70	250	ppm/V
LOAD REGULATION	$\Delta V_{OUT}/\Delta I_{LOAD}$	V_S = 6.0 V, 0 mA to 5 mA				
T Grade				30	300	ppm/mA
SUPPLY CURRENT	I_S	@ 25°C		11	15	µA
				15	20	µA
THERMAL HYSTERESIS	$V_{OUT-HYS}$					
T Grade				157		ppm

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	18 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−55°C to +125°C
Junction Temperature Range	−65°C to +150°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.

THERMAL RESISTANCE

θ_{JA} is specified for worst-case conditions; that is, θ_{JA} is specified for the device in socket testing. In practice, θ_{JA} is specified for the device soldered in a circuit board.

Table 5. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead TSSOP (RU-8)	240	43	°C/W

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.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25°C, unless otherwise noted.

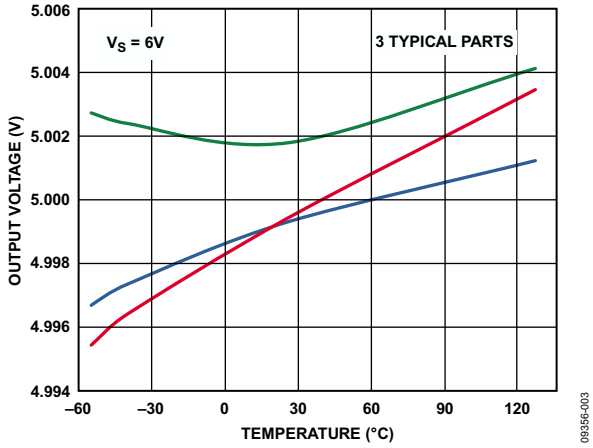

Figure 2. V_{OUT} vs. Temperature

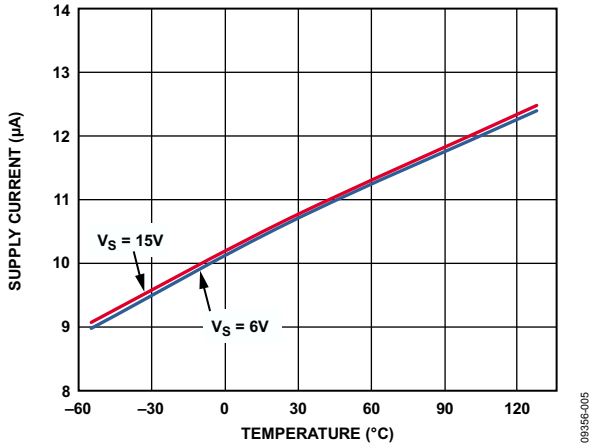

Figure 3. Supply Current vs. Temperature

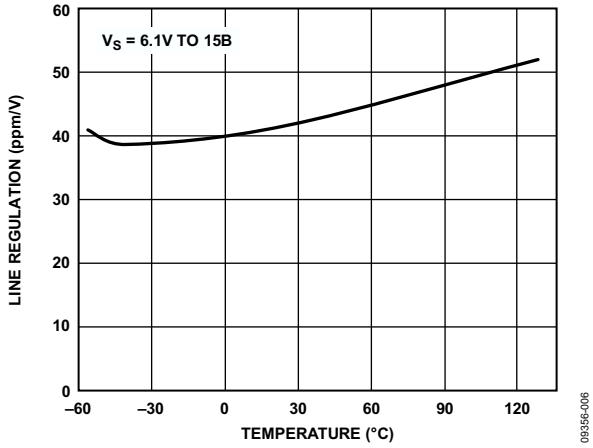

Figure 4. Line Regulation vs. Temperature

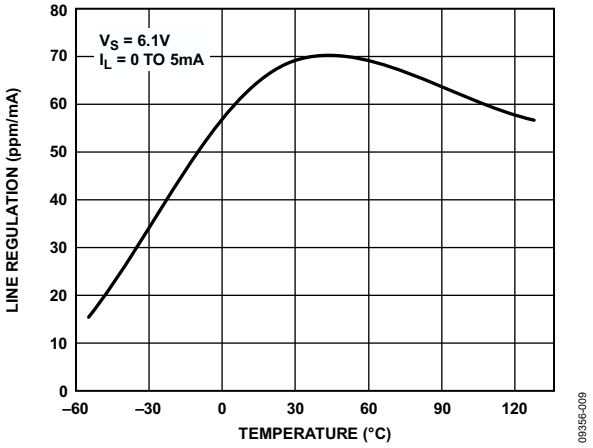

Figure 5. Load Regulation vs. Temperature

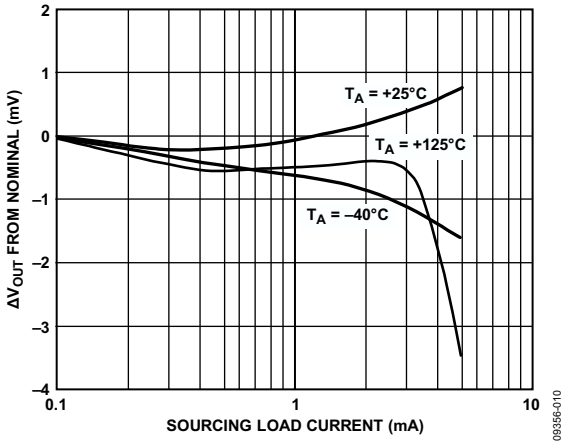

Figure 6. ΔV_{OUT} from Nominal vs. Load Current

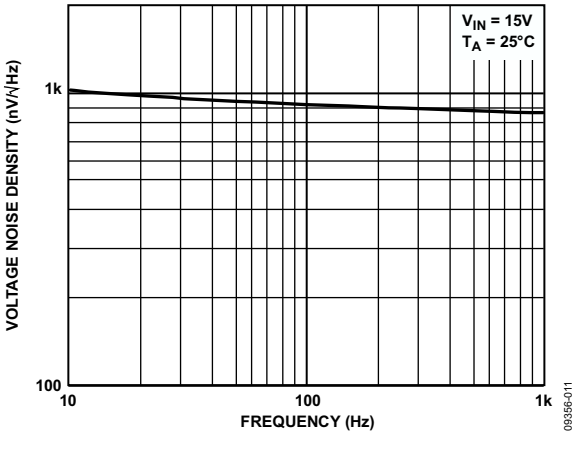

Figure 7. Voltage Noise Density vs. Frequency

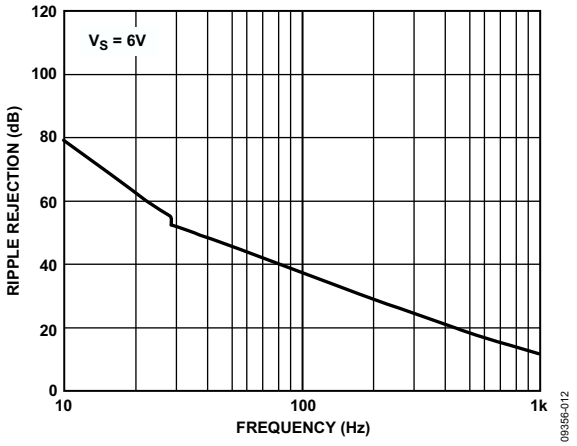

Figure 8. Ripple Rejection vs. Frequency

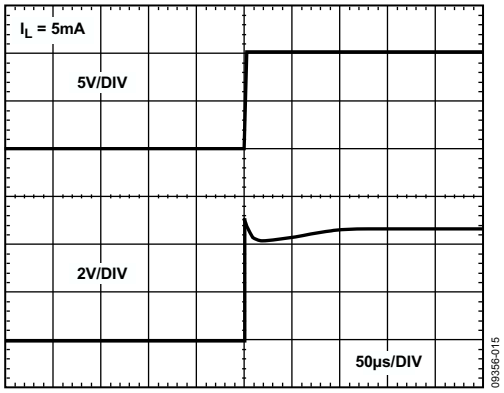

Figure 11. Turn-On Time

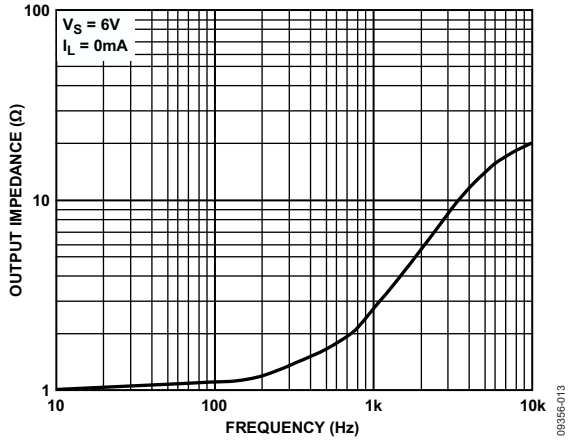

Figure 9. Output Impedance vs. Frequency

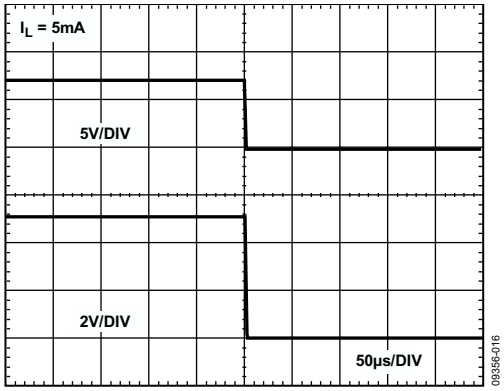

Figure 12. Turn-Off Time

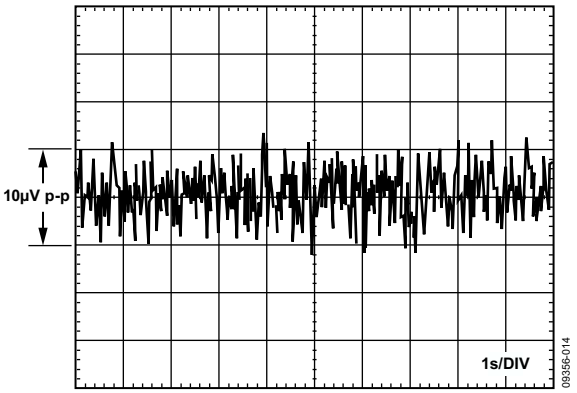

Figure 10. 0.1 Hz to 10 Hz Noise

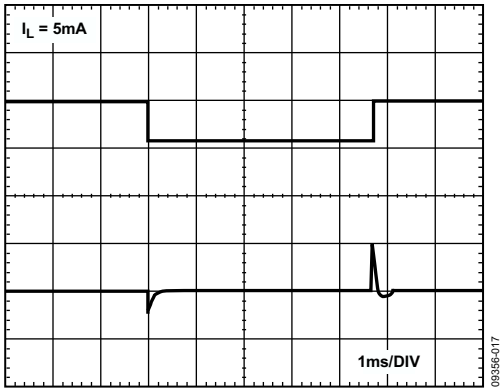

Figure 13. Load Transient Response

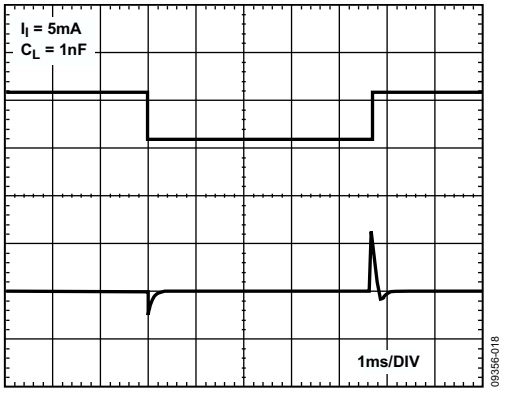

Figure 14. Load Transient Response

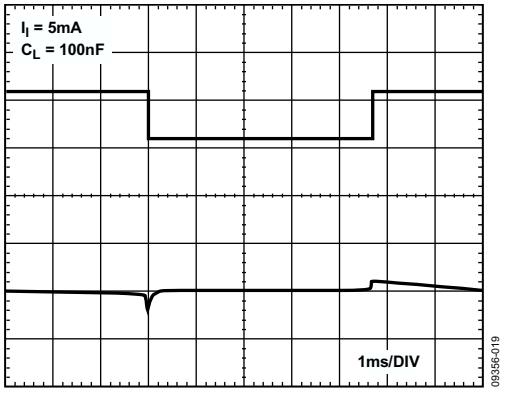

Figure 15. Load Transient Response

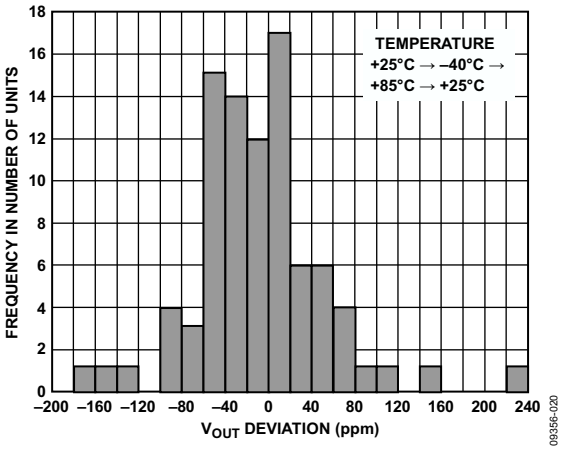

Figure 16. Typical Hysteresis for the ADR29x Product

OUTLINE DIMENSIONS

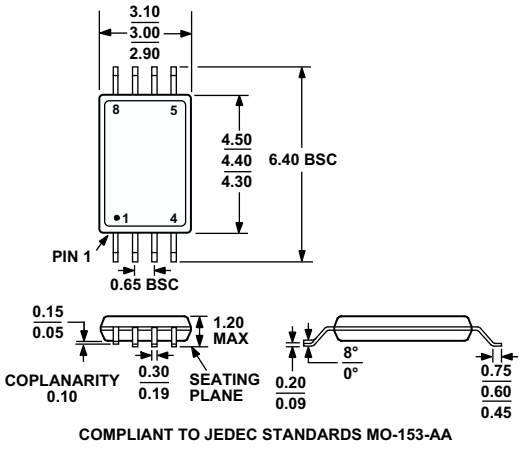

Figure 17. 8-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-8)
Dimensions shown in millimeters

ORDERING GUIDE

Model	Output Voltage (V)	Initial Accuracy (%)	Temperature Coefficient (ppm/°C max)	Temperature Range	Package Description	Package Option	Ordering Quantity
ADR293TRU-EP	5.00	0.20	30	−55°C to +125°C	8-Lead TSSOP	RU-8	96
ADR293TRU-EP-R7	5.00	0.20	30	−55°C to +125°C	8-Lead TSSOP	RU-8	1,000

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