

## FEATURES

- 6.0 V to 15 V supply range**
- Supply current: 15  $\mu$ A maximum**
- Low noise: 15  $\mu$ V 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 ( $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ )**
- Controlled manufacturing baseline**
- 1 assembly/test site**
- 1 fabrication site**
- Product change notification**
- Qualification data available on request**

## APPLICATIONS

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

## 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  $\mu$ A maximum, making this device ideal for battery powered instrumentation. The temperature coefficient

is 30 ppm/ $^{\circ}\text{C}$  maximum over the military temperature range, and the initial error is only 0.2% at 25 $^{\circ}\text{C}$ . 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  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . This device is available in an 8-lead TSSOP package.

Additional applications information is available in the [ADR293 data sheet](#).

## PIN CONFIGURATION

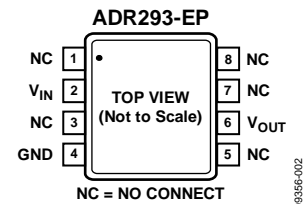


Figure 1. 8-Lead TSSOP (RU-8)

**TABLE OF CONTENTS**

Features.....	1	Electrical Specifications.....	3
Enhanced Product Features.....	1	Absolute Maximum Ratings.....	5
Applications.....	1	Thermal Resistance.....	5
Pin Configuration.....	1	ESD Caution.....	5
General Description.....	1	Typical Performance Characteristics.....	6
Revision History.....	2	Outline Dimensions.....	9
Specifications.....	3	Ordering Guide.....	9

**REVISION HISTORY**

**4/2018—Rev. 0 to Rev. A**

Change to Enhanced Product Features Section.....	1
Changes to Ordering Guide.....	9

**9/2010—Revision 0: Initial Version**

## SPECIFICATIONS

### ELECTRICAL SPECIFICATIONS

$V_S = 6.0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 1.

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

$V_S = 6.0\text{ V}$ ,  $T_A = -25^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise noted.

Table 2.

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

$V_S = 6.0\text{ V}$ ,  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.

**Table 3.**

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
TEMPERATURE COEFFICIENT T Grade	$TCV_{OUT}$	$I_{OUT} = 0\text{ mA}$		10	30	ppm/ $^\circ\text{C}$
LINE REGULATION T Grade	$\Delta V_{OUT}/\Delta V_{IN}$	6.0 V to 15 V, $I_{OUT} = 0\text{ mA}$		70	250	ppm/V
LOAD REGULATION T Grade	$\Delta V_{OUT}/\Delta I_{LOAD}$	$V_S = 6.0\text{ V}$ , 0 mA to 5 mA		30	300	ppm/mA
SUPPLY CURRENT	$I_S$	@ $25^\circ\text{C}$		11	15	$\mu\text{A}$
				15	20	$\mu\text{A}$
THERMAL HYSTERESIS T Grade	$V_{OUT-HYS}$			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 at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## THERMAL RESISTANCE

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

Table 5. Thermal Resistance

Package Type	$\theta_{JA}$	$\theta_{JC}$	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<sub>A</sub> = 25°C, unless otherwise noted.

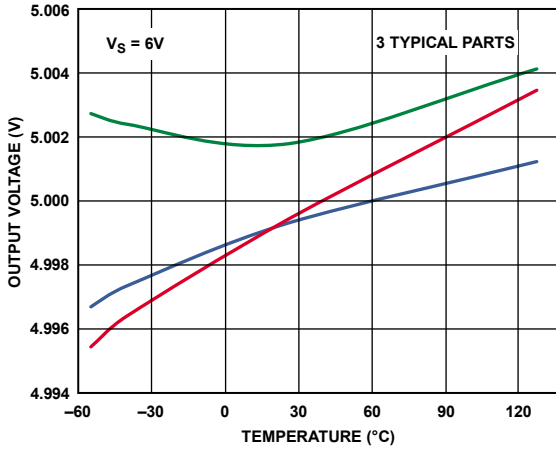


Figure 2. V<sub>OUT</sub> vs. Temperature

09356-003

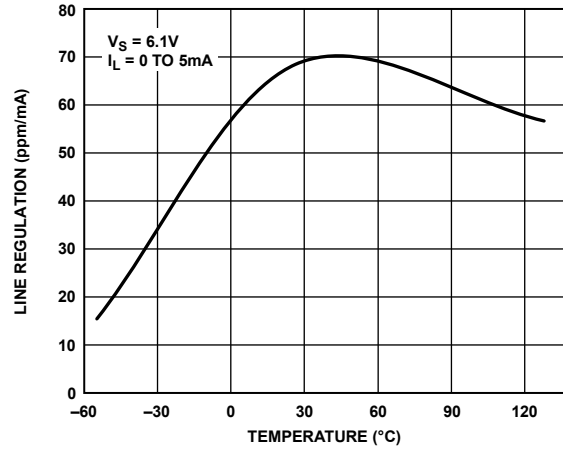


Figure 5. Load Regulation vs. Temperature

09356-009

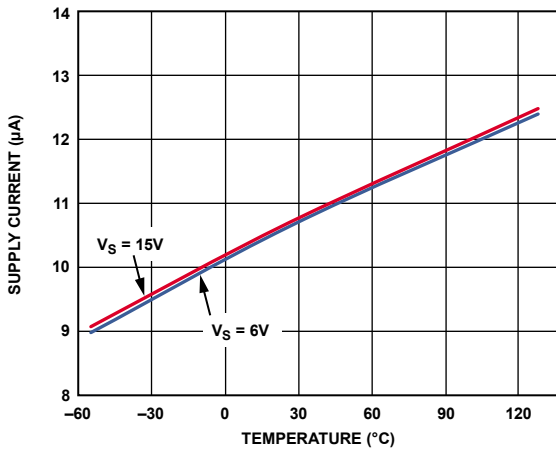


Figure 3. Supply Current vs. Temperature

09356-005

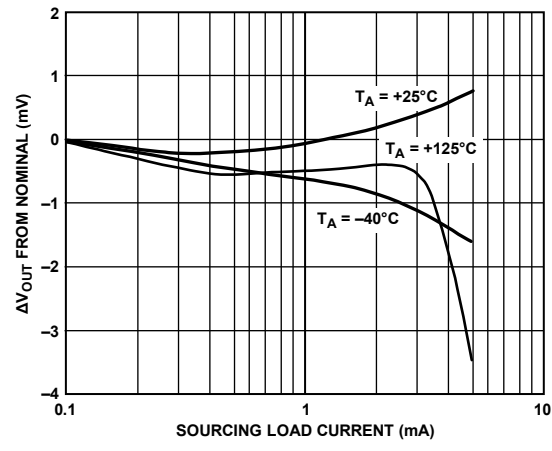


Figure 6. ΔV<sub>OUT</sub> from Nominal vs. Load Current

09356-010

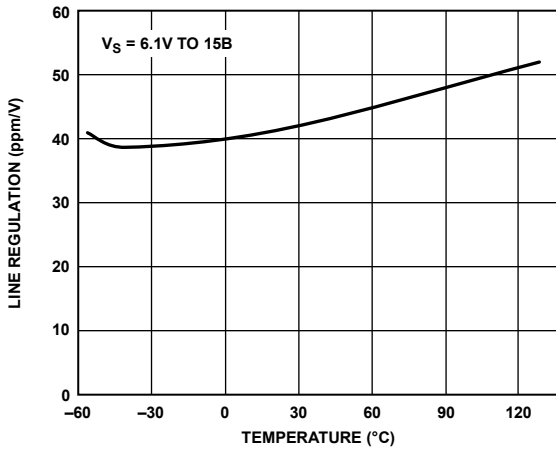


Figure 4. Line Regulation vs. Temperature

09356-006

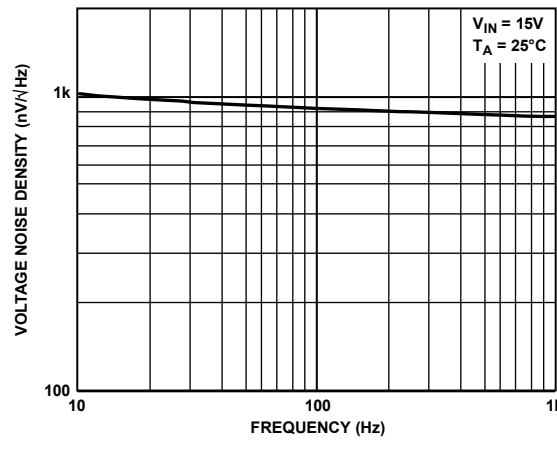


Figure 7. Voltage Noise Density vs. Frequency

09356-011

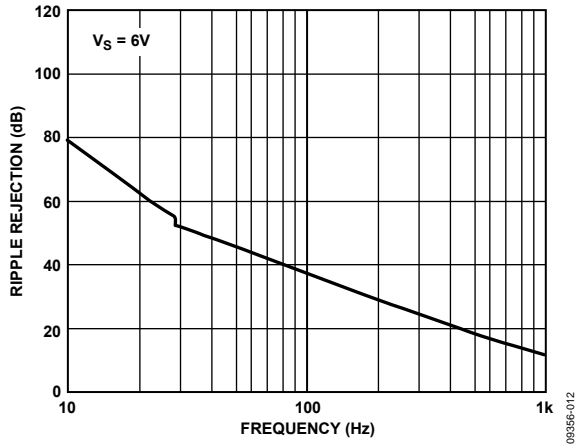


Figure 8. Ripple Rejection vs. Frequency

09356-012

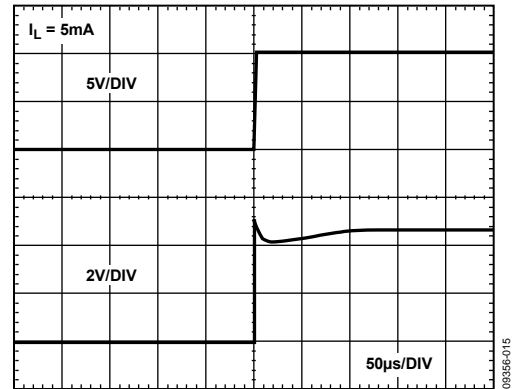


Figure 11. Turn-On Time

09356-015

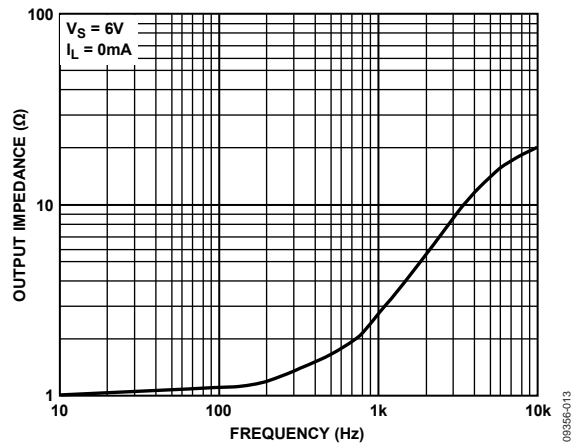


Figure 9. Output Impedance vs. Frequency

09356-013

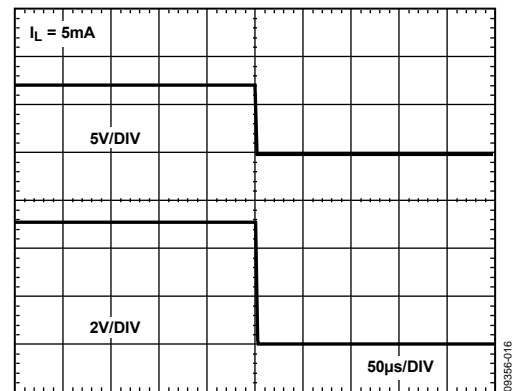


Figure 12. Turn-Off Time

09356-016

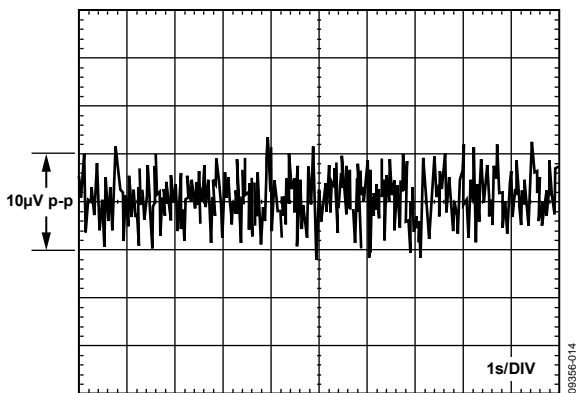


Figure 10. 0.1 Hz to 10 Hz Noise

09356-014

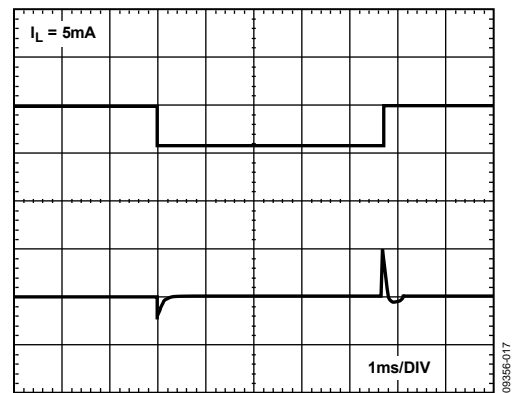


Figure 13. Load Transient Response

09356-017

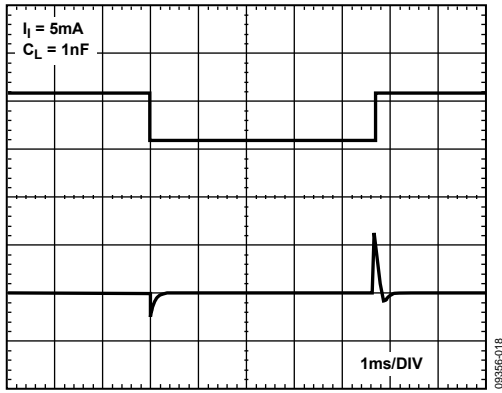


Figure 14. Load Transient Response

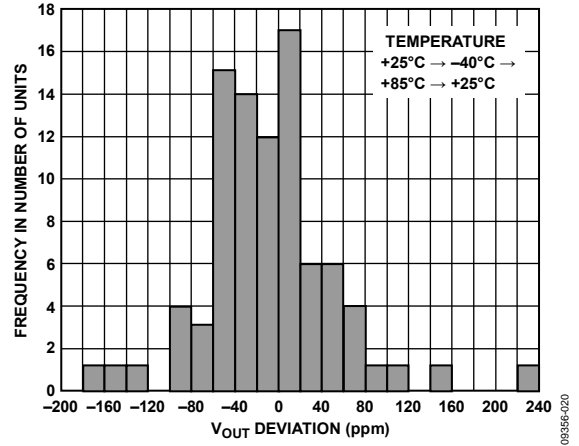


Figure 16. Typical Hysteresis for the ADR29x Product

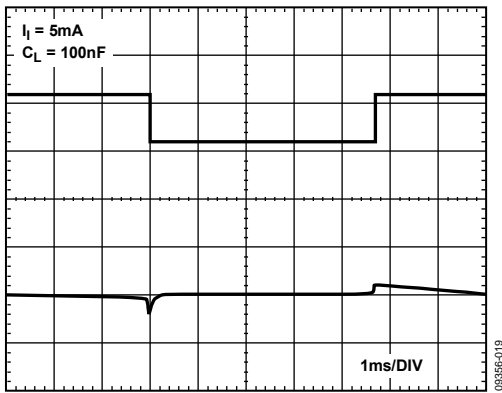
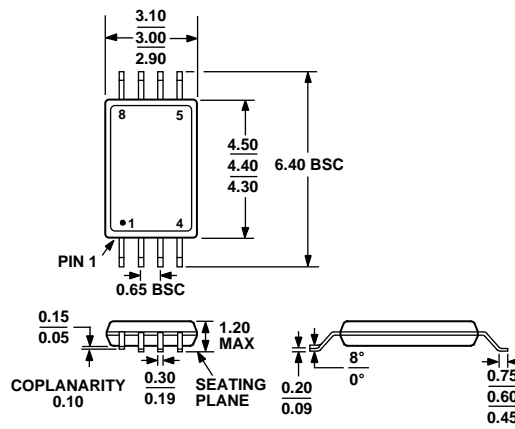


Figure 15. Load Transient Response



### OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AA

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

Dimensions shown in millimeters

### ORDERING GUIDE

Model <sup>1</sup>	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
ADR293TRUZ-EP	5.00	0.20	30	-55°C to +125°C	8-Lead TSSOP	RU-8	96
ADR293TRUZ-EP-R7	5.00	0.20	30	-55°C to +125°C	8-Lead TSSOP	RU-8	1,000

<sup>1</sup> Z = RoHS Compliant Part.

**NOTES**

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