

FEATURES

- 6.0 V to 15 V supply range**
- Supply current: 15 μ A maximum**
- Low noise: 15 μ 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°C to $+125^{\circ}\text{C}$)**
- 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**

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 μ 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°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

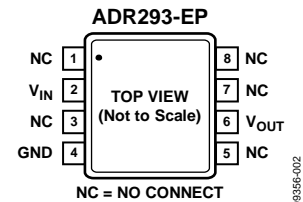


Figure 1. 8-Lead TSSOP (RU-8)

Rev. 0

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

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

9/10—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	ΔV_{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		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/ $^\circ\text{C}$
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

ADR293-EP

$V_S = 6.0\text{ V}$, $T_A = -55^\circ\text{C}$ 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°C		11	15	μA
				15	20	μA
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 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

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

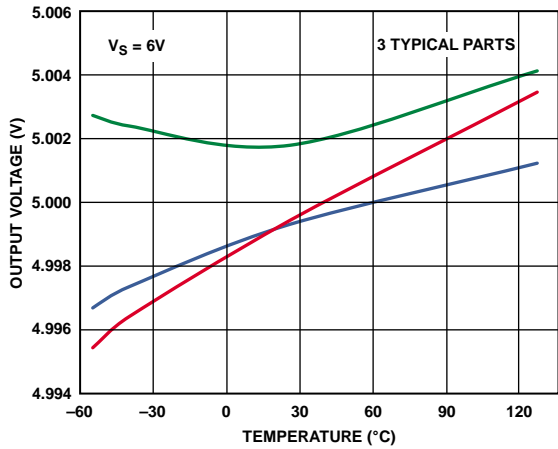


Figure 2. V_{OUT} vs. Temperature

09356-003

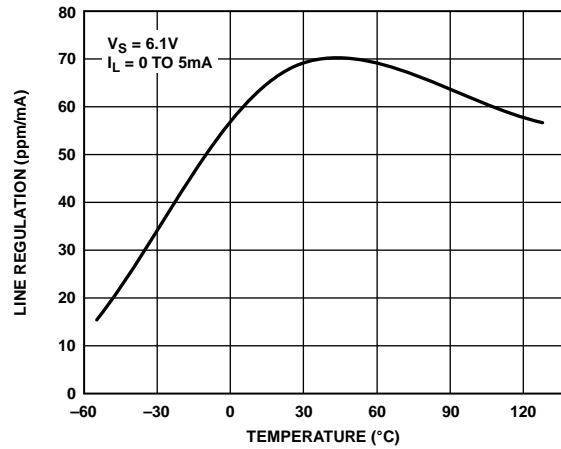


Figure 5. Load Regulation vs. Temperature

09356-009

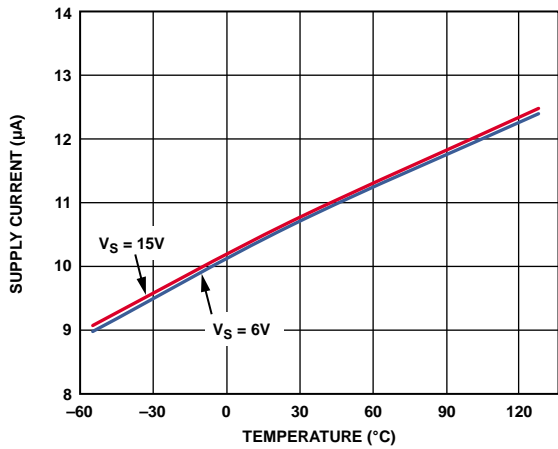


Figure 3. Supply Current vs. Temperature

09356-005

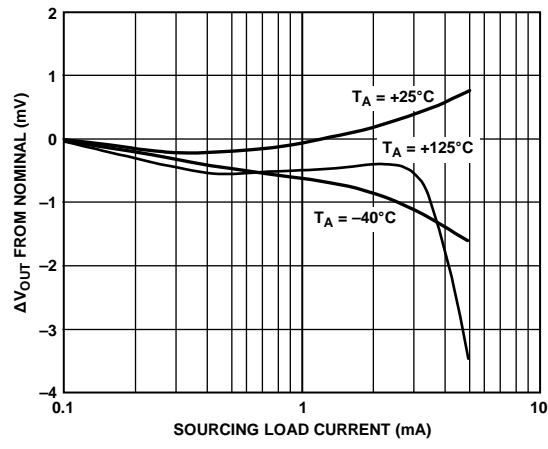


Figure 6. ΔV_{OUT} from Nominal vs. Load Current

09356-010

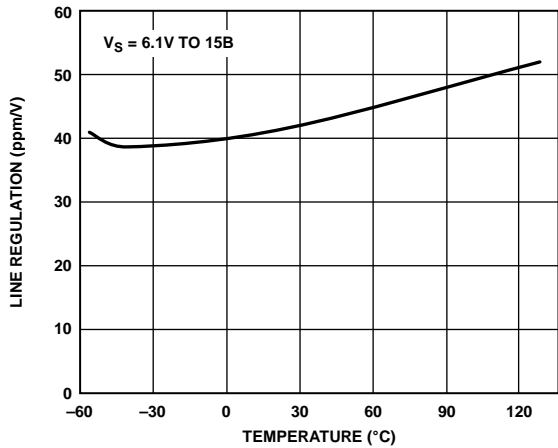


Figure 4. Line Regulation vs. Temperature

09356-006

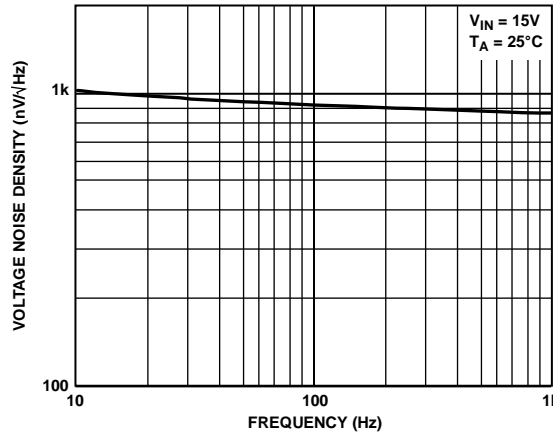


Figure 7. Voltage Noise Density vs. Frequency

09356-011

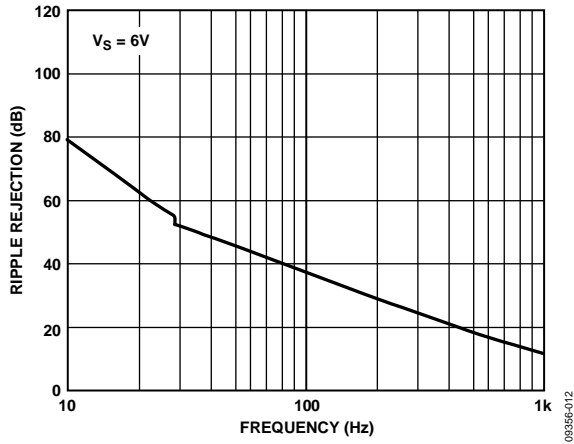


Figure 8. Ripple Rejection vs. Frequency

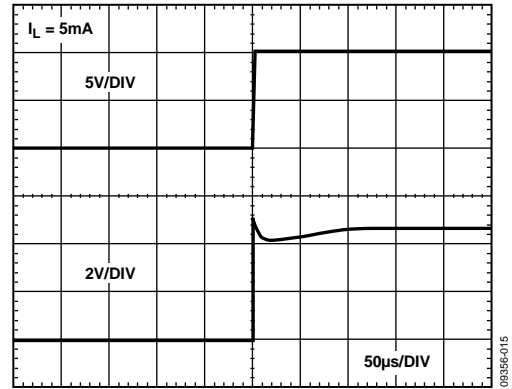


Figure 11. Turn-On Time

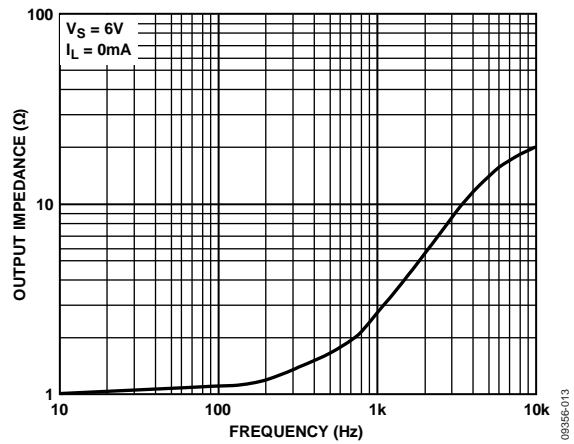


Figure 9. Output Impedance vs. Frequency

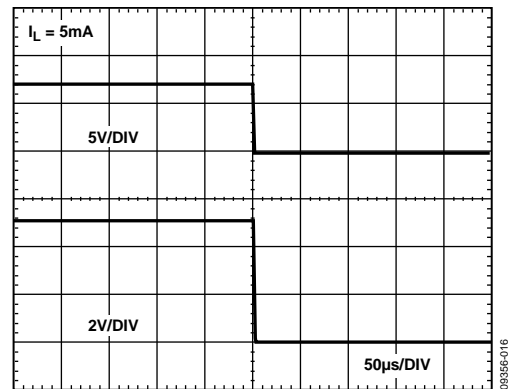


Figure 12. Turn-Off Time

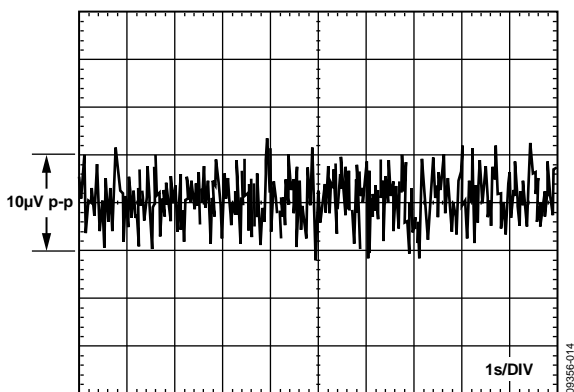


Figure 10. 0.1 Hz to 10 Hz Noise

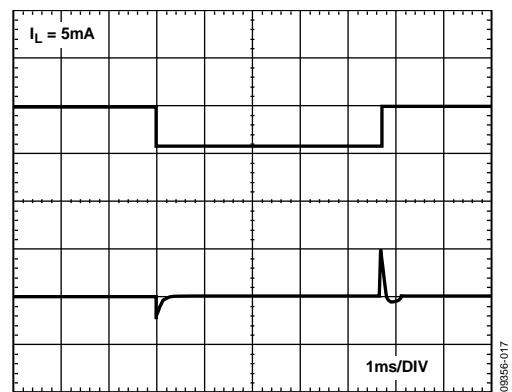


Figure 13. Load Transient Response

ADR293-EP

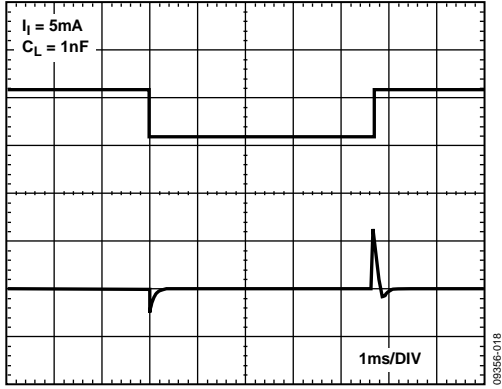


Figure 14. Load Transient Response

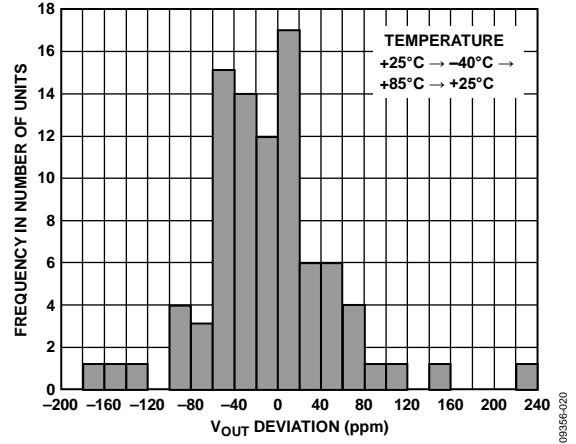


Figure 16. Typical Hysteresis for the ADR29x Product

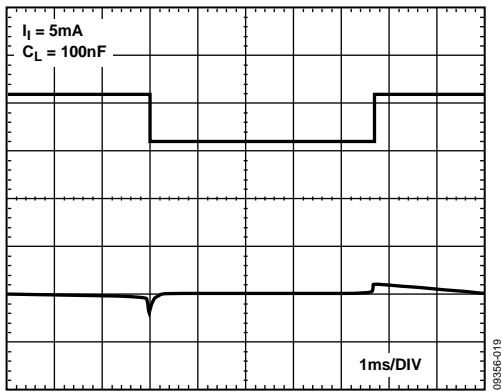


Figure 15. Load Transient Response

OUTLINE DIMENSIONS

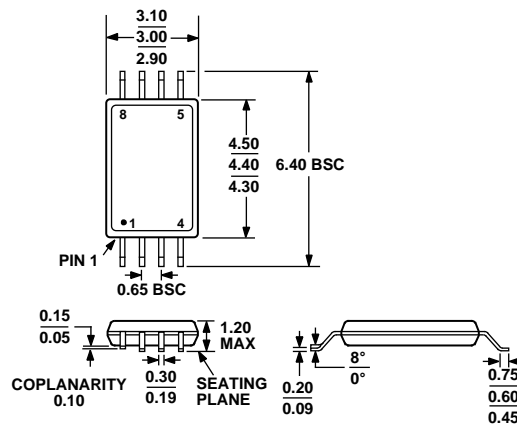


Figure 17. 8-Lead Thin Shrink Small Outline Package [TSSOP] (RU-8)

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

ADR293-EP

NOTES

NOTES

ADR293-EP

NOTES