

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
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°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

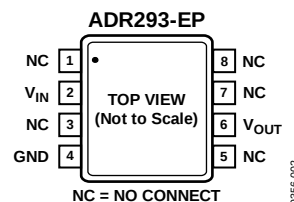


Figure 1. 8-Lead TSSOP (RU-8)

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REVISION HISTORY

4/2018—Rev. 0 to Rev. A

Change to Enhanced Product Features Section.....	1
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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	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		$\text{nV}/\sqrt{\text{Hz}}$

$V_S = 6.0\text{ V}$, $T_A = -25^\circ\text{C}$ 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/ $^\circ\text{C}$
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

$V_S = 6.0\text{ V}$, $T_A = -55^\circ\text{C}$ 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 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

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.

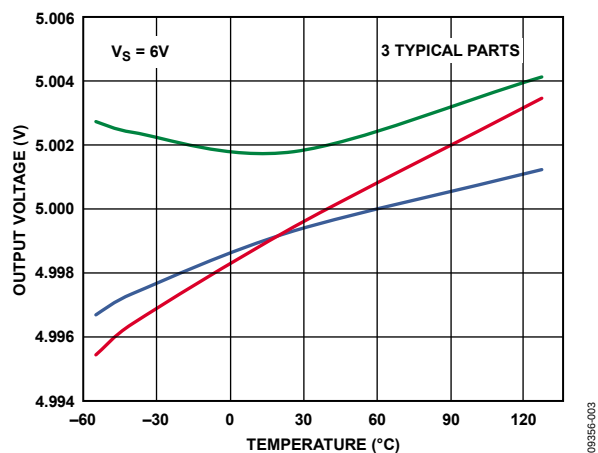


Figure 2. V_{OUT} vs. Temperature

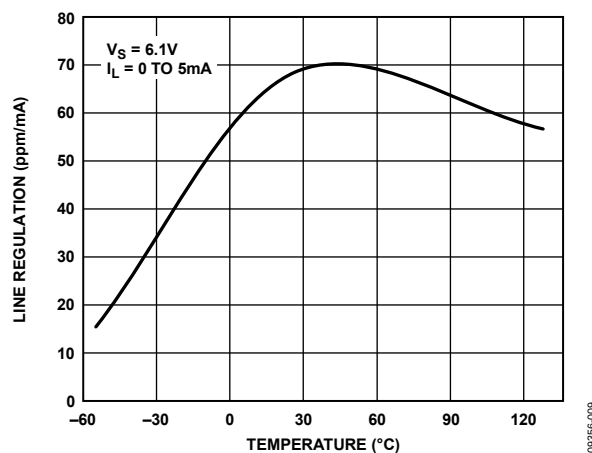


Figure 5. Load Regulation vs. Temperature

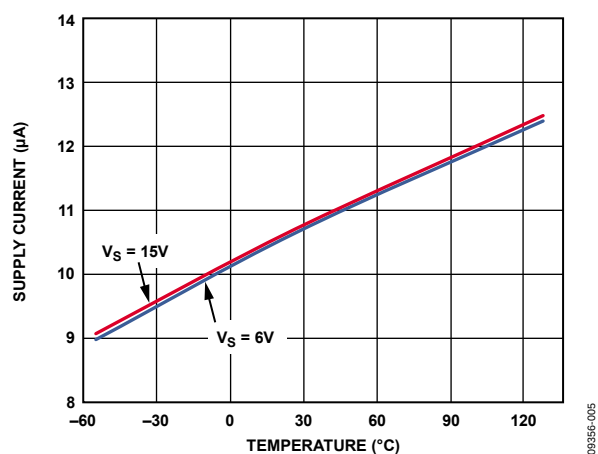


Figure 3. Supply Current vs. Temperature

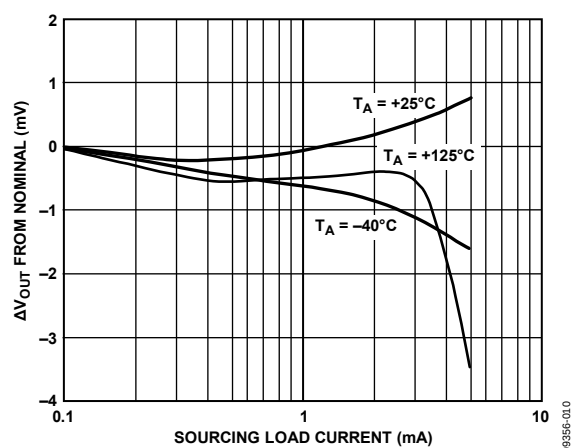


Figure 6. ΔV_{OUT} from Nominal vs. Load Current

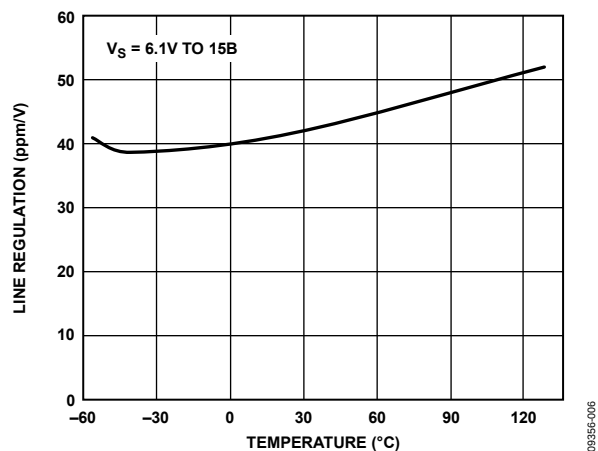


Figure 4. Line Regulation vs. Temperature

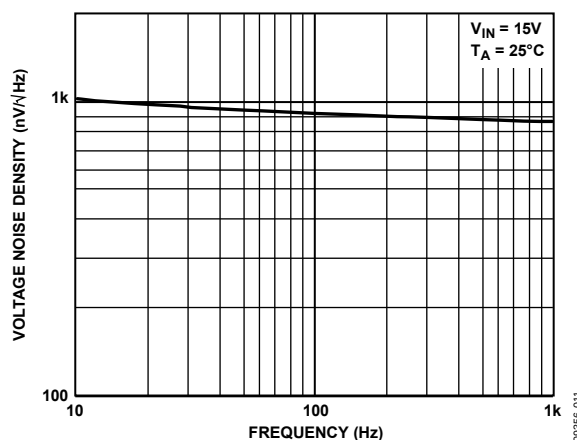


Figure 7. Voltage Noise Density vs. Frequency

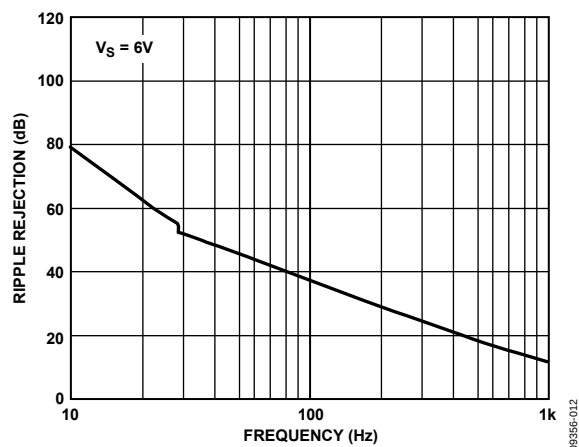


Figure 8. Ripple Rejection vs. Frequency

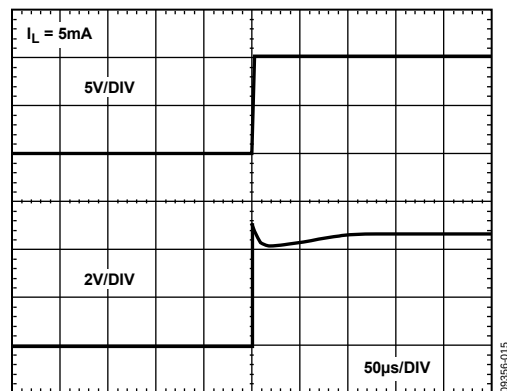


Figure 11. Turn-On Time

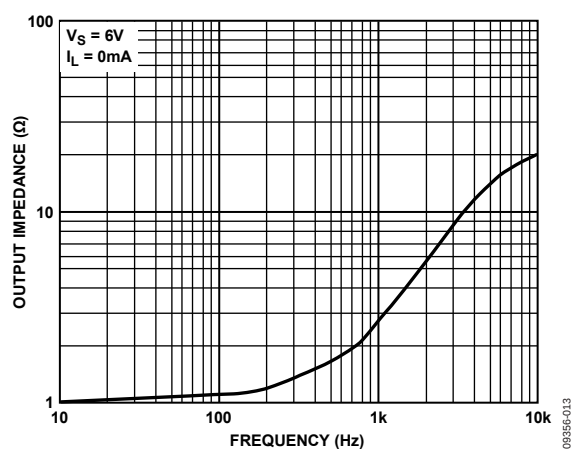


Figure 9. Output Impedance vs. Frequency

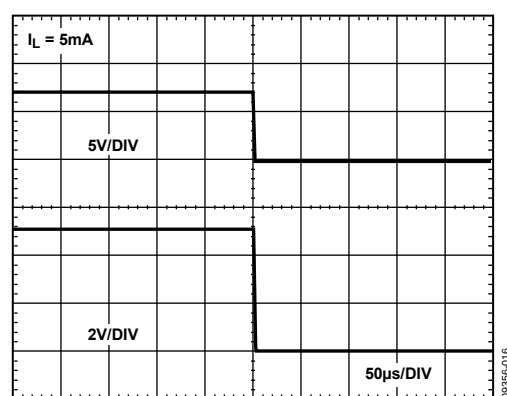


Figure 12. Turn-Off Time

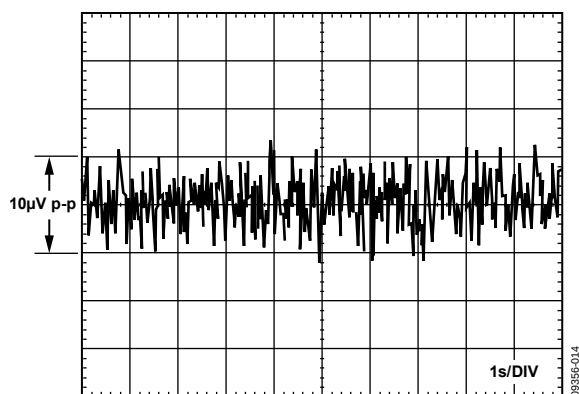


Figure 10. 0.1 Hz to 10 Hz Noise

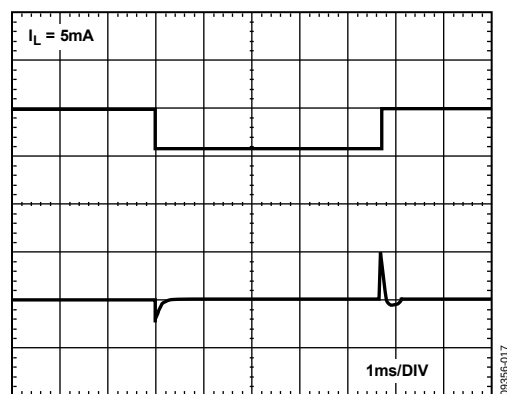


Figure 13. Load Transient Response

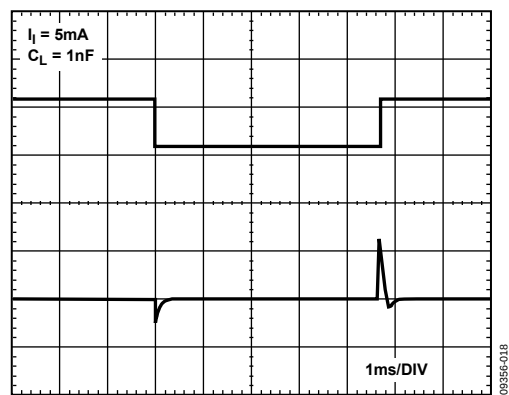


Figure 14. Load Transient Response

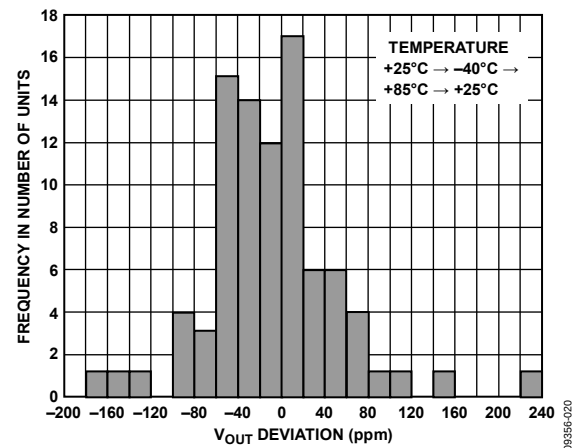


Figure 16. Typical Hysteresis for the ADR29x Product

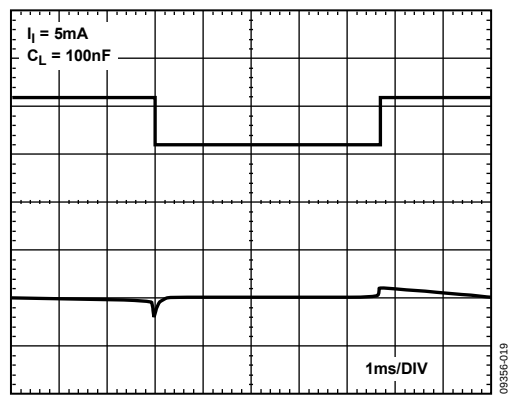


Figure 15. Load Transient Response

OUTLINE DIMENSIONS

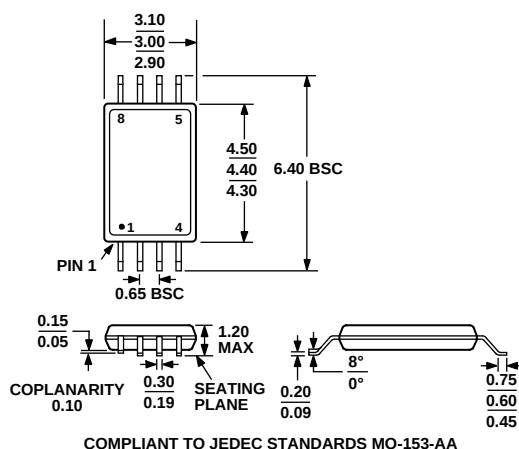


Figure 17. 8-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-8)

Dimensions shown in millimeters

ORDERING GUIDE

Model ¹	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

¹ Z = RoHS Compliant Part.

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