Ultralow Noise, LDO XFET Voltage Reference with Current Sink and Source

Enhanced Product

ADR441-EP

FEATURES

- Ultralow voltage noise (0.1 Hz to 10 Hz): 1.2 µV p-p
- Superb temperature drift: 5 ppm/°C
- Low dropout operation (supply voltage headroom): 500 mV
- Supply voltage operating range: 3 V to 18 V
- High output source and sink current
  - +10 mA and −5 mA, respectively

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
- Product change notification
- Qualification data available on request

APPLICATIONS

- Precision data acquisition systems
- High resolution data converters
- Battery-powered instrumentation
- Precision instruments
- Military communication
- Unmanned systems
- Avionics

TYPICAL APPLICATION CIRCUIT

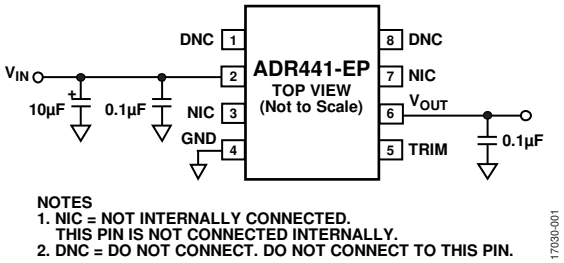

Figure 1.

GENERAL DESCRIPTION

The ADR441-EP[1] is a XFET® voltage reference featuring ultralow noise, high accuracy, and low temperature drift performance. Using Analog Devices, Inc., temperature drift curvature correction and extra implanted junction FET (XFET) technology, voltage change vs. temperature nonlinearity in the ADR441-EP is greatly minimized.

The XFET reference offers better noise performance than buried Zener references, and the XFET reference operates off low supply voltage headroom (500 mV). This combination of features makes the ADR441-EP ideally suited for precision signal conversion applications in high end data acquisition systems, military communication, and avionics applications.

The ADR441-EP has the capability to source up to +10 mA of output current and sink up to −5 mA. The device also comes with a trim terminal to adjust the output voltage over a 0.5% range without compromising performance.

The ADR441-EP is available in an 8-lead, narrow SOIC package. The ADR441-EP is specified over the military temperature range of −55°C to +125°C. Additional application and technical information can be found in the ADR441 data sheet.

[1] Protected by U.S. Patent Number 5,838,192.

Rev. 0 Document Feedback

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700

Technical Support www.analog.com

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REVISION HISTORY

7/2018—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

V_{IN} = 3 V to 18 V, T_A = 25°C, and input capacitance (C_{IN}) = output capacitance (C_{OUT}) = 0.1 µF, unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
OUTPUT VOLTAGE	V_{OUT}		2.499	2.500	2.501	V
INITIAL ACCURACY	V_{OERR}				±1	mV
					0.04	%
TEMPERATURE DRIFT	TCV_{OUT}	−55°C < T_A < +125°C		1	5	ppm/°C
REGULATION						
Line	$\Delta V_{OUT}/\Delta V_{IN}$	−55°C < T_A < +125°C		10	20	ppm/V
Load	$\Delta V_{OUT}/\Delta I_{LOAD}$	Load current (I_{LOAD}) = 0 mA to 10 mA, V_{IN} = 4 V,				
		−55°C < T_A < +125°C	−50		+50	ppm/mA
	$\Delta V_{OUT}/\Delta I_{LOAD}$	I_{LOAD} = 0 mA to −5 mA, V_{IN} = 4 V, −55°C < T_A < +125°C	−50		+50	ppm/mA
OUTPUT CURRENT CAPACITY	I_{LOAD}					
Sourcing				10		mA
Sinking				−5		mA
QUIESCENT CURRENT	I_{IN}	No load, −55°C < T_A < +125°C		3	3.75	mA
VOLTAGE NOISE	e_N p-p	0.1 Hz to 10 Hz		1.2		µV p-p
Density	e_N	1 kHz		48		nV/√Hz
TURN-ON SETTLING TIME	t_R			10		µs
LONG-TERM STABILITY[1]	ΔV_{OUT}	1000 hours		50		ppm
OUTPUT VOLTAGE HYSTERESIS	V_{OUT_HYS}			70		ppm
RIPPLE REJECTION RATIO	RRR	Input frequency (f_{IN}) = 1 kHz		−80		dB
SHORT CIRCUIT TO GND	I_{SC}			27		mA
SUPPLY VOLTAGE						
Operating Range	V_{IN}		3		18	V
Headroom	$V_{IN} - V_{OUT}$		500			mV

[1] The long-term stability specification is noncumulative. The drift in the subsequent 1000 hour period is significantly lower than in the first 1000 hour period.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Rating
Supply Voltage	20 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

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

θ_{JA} is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure.

θ_{JC} is the junction to case thermal resistance.

Table 3. Thermal Resistance

Package Type[1]	θ_{JA}	θ_{JC}	Unit
R-8	130	43	°C/W

[1] Thermal impedance simulated values are based on a JEDEC 2S2P thermal test board. See JEDEC JESD-51.

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

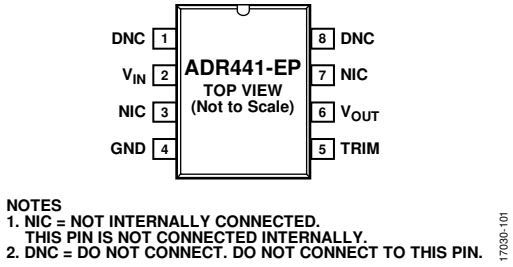


Figure 2. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1, 8	DNC	Do Not Connect. Do not connect to these pins.
2	V_{IN}	Input Voltage Connection.
3, 7	NIC	Not Internally Connected. These pins are not connected internally.
4	GND	Ground.
5	TRIM	Output Voltage Trim.
6	V_{OUT}	Output Voltage.

TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 7 V, T_A = 25°C, and C_{IN} = C_{OUT} = 0.1 µF, unless otherwise noted.

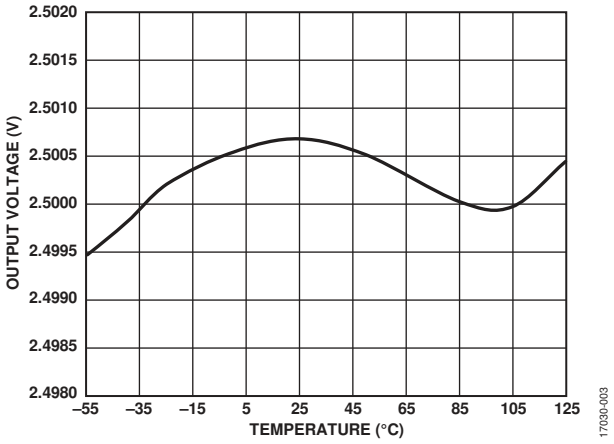


Figure 3. Output Voltage vs. Temperature

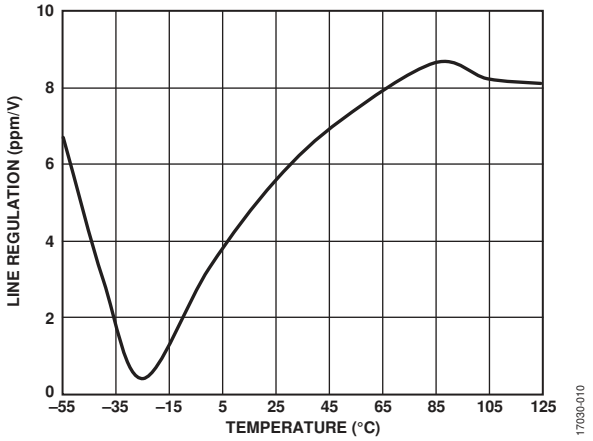


Figure 6. Line Regulation vs. Temperature

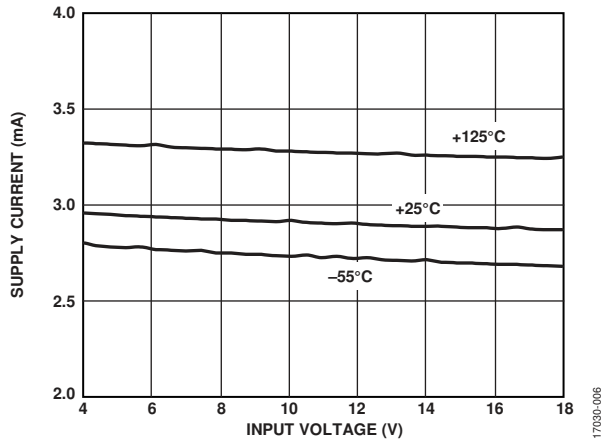


Figure 4. Supply Current vs. Input Voltage for Various Temperatures

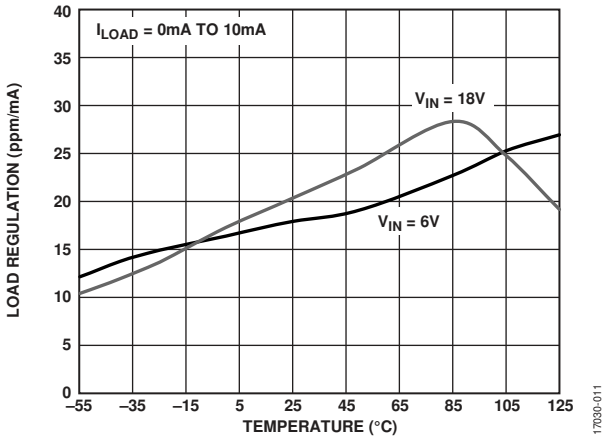


Figure 7. Load Regulation vs. Temperature for Various Input Voltages

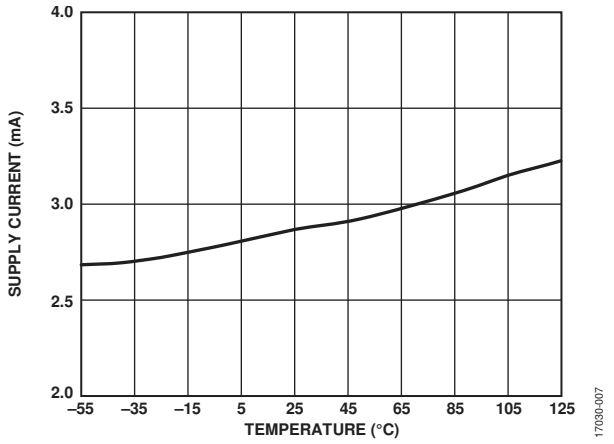


Figure 5. Supply Current vs. Temperature

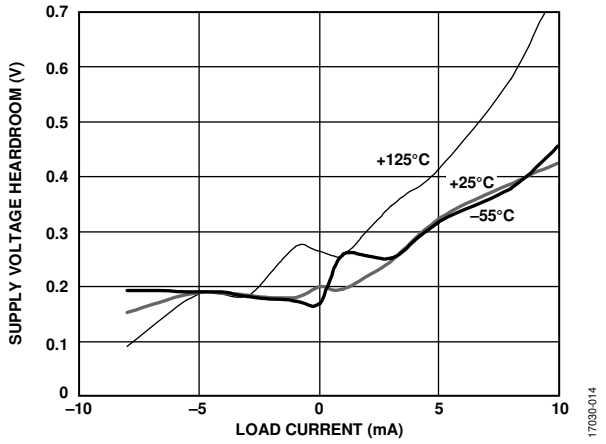


Figure 8. Supply Voltage Headroom vs. Load Current for Various Temperatures

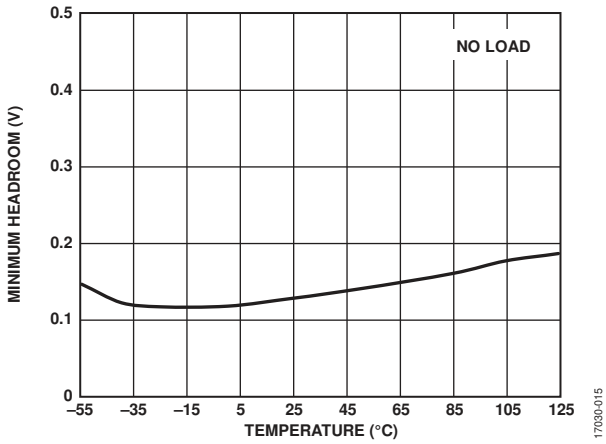
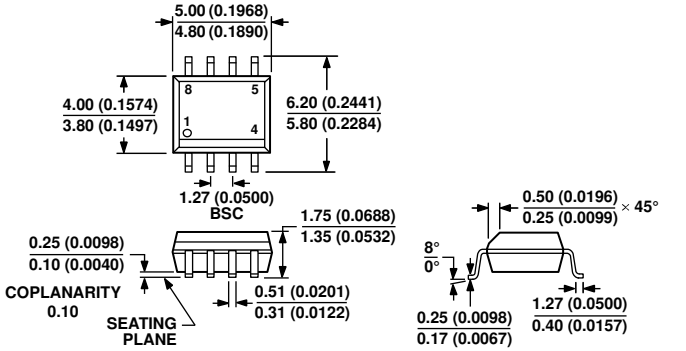


Figure 9. Minimum Headroom vs. Temperature

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AA
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

012407-A

Figure 10. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model[1]	Output Voltage (V)	Initial Accuracy		Temperature Drift (ppm/°C)	Temperature Range	Package Description	Package Option
		±mV	%				
ADR441TRZ-EP	2.500	1	0.04	5	−55°C to +125°C	8-Lead SOIC_N	R-8
ADR441TRZ-EP-R7	2.500	1	0.04	5	−55°C to +125°C	8-Lead SOIC_N	R-8

[1] Z = RoHS Compliant Part.