



**THE DATASHEET OF
ADR431TRZ-EP**



FEATURES

Low noise (0.1 Hz to 10.0 Hz): 3.5 μV p-p at 2.5 V_o typical
([ADR431-EP](#))

No external capacitor required

Low temperature coefficient

5 ppm/ $^{\circ}\text{C}$ maximum ([ADR431-EP](#))

3 ppm/ $^{\circ}\text{C}$ maximum ([ADR434-EP/ADR435-EP](#))

Load regulation: 15 ppm/mA maximum

Line regulation: 20 ppm/V maximum

Wide supply voltage operating range: 4.5 V to 18 V
([ADR431-EP](#))

High output source and sink current: +10 mA and -10 mA

ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications, aerospace
qualified electronic component (AQEC) standard

Military temperature range: -55 $^{\circ}\text{C}$ to +125 $^{\circ}\text{C}$

Controlled manufacturing baseline

One assembly and test site

One fabrication site

Enhanced product change notification

Qualification data available on request

APPLICATIONS

Precision data acquisition systems

High resolution data converters

Optical control circuits

Precision instruments

GENERAL DESCRIPTION

The [ADR431-EP/ADR434-EP/ADR435-EP](#) are XFET[®] voltage references featuring low noise, high accuracy, and low temperature drift performance. Using Analog Devices, Inc., patented temperature drift curvature correction and eXtra implanted junction FET (XFET) technology, voltage change vs. temperature nonlinearity in the [ADR431-EP/ADR434-EP/ADR435-EP](#) is minimized.

The XFET references operate at lower current (800 μA) and lower supply voltage headroom (2 V) than buried Zener references. Buried Zener references require more than 5 V headroom for operation. The [ADR431-EP/ADR434-EP/ADR435-EP](#) XFET references are optimal low noise solutions for 5 V systems.

PIN CONFIGURATION



NOTES

1. NIC = NOT INTERNALLY CONNECTED. THIS PIN IS NOT CONNECTED INTERNALLY.
2. DNC = DO NOT CONNECT. DO NOT CONNECT TO THIS PIN.

Figure 1. 8-Lead SOIC_N (R-8)

The [ADR431-EP/ADR434-EP/ADR435-EP](#) have the capability to source up to +10 mA of output current and sink up to -10 mA. They also come with a trim terminal to adjust the output voltage over a 0.5% range without compromising performance.

The [ADR431-EP/ADR434-EP/ADR435-EP](#) are available in an 8-lead narrow SOIC package and are specified over the military temperature range of -55 $^{\circ}\text{C}$ to +125 $^{\circ}\text{C}$.

Additional application and technical information can be found in the [ADR430/ADR431/ADR433/ADR434/ADR435](#) data sheet.

Table 1. Selection Guide

| Model | Output Voltage (V) | Accuracy (mV) | Temperature Coefficient (ppm/ $^{\circ}\text{C}$) |
|----------------------------|--------------------|---------------|--|
| ADR431T-EP | 2.500 | ± 1.0 | 5 |
| ADR434T-EP | 4.096 | ± 1.5 | 3 |
| ADR435T-EP | 5.000 | ± 2.0 | 3 |

Rev. B

Document Feedback

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REVISION HISTORY

5/2017—Rev. A to Rev. B

| | |
|--|------------|
| Deleted ADR439 | Throughout |
| Added Pin Configuration and Function Descriptions Section, Figure 2; Renumbered Sequentially, and Table 7 | 7 |
| Changes to Typical Performance Characteristics Section..... | 8 |

8/2010—Rev. 0 to Rev. A

| | |
|---------------------------------|------------|
| Added ADR431-EP..... | Throughout |
| Added ADR435-EP..... | Throughout |
| Changes to Ordering Guide | 8 |

7/2010—Revision 0: Initial Version

SPECIFICATIONS

ADR431-EP ELECTRICAL CHARACTERISTICS

$V_{IN} = 4.5 \text{ V to } 18 \text{ V}$, $I_L = 0 \text{ mA}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 2.

| Parameter | Symbol | Test Conditions/Comments | Min | Typ | Max | Unit |
|----------------------------------|------------------------------|---|-------|-------|-------------------------|------------------------|
| OUTPUT VOLTAGE | V_O | | 2.499 | 2.500 | 2.501 | V |
| INITIAL ACCURACY | V_{OERR} | | | | ± 1.0 ± 0.04 | mV % |
| TEMPERATURE COEFFICIENT | TCV_O | $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 1.5 | 5 | ppm/ $^\circ\text{C}$ |
| LINE REGULATION | $\Delta V_O / \Delta V_{IN}$ | $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 5 | 20 | ppm/V |
| LOAD REGULATION | $\Delta V_O / \Delta I_L$ | $I_L = 0 \text{ mA to } 10 \text{ mA}$, $V_{IN} = 5 \text{ V}$, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ $I_L = -10 \text{ mA to } 0 \text{ mA}$, $V_{IN} = 5 \text{ V}$, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | | 15 15 | ppm/mA ppm/mA |
| QUIESCENT CURRENT | I_{IN} | No load, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 580 | 800 | μA |
| VOLTAGE NOISE | e_N p-p | 0.1 Hz to 10.0 Hz | | 3.5 | | $\mu\text{V p-p}$ |
| VOLTAGE NOISE DENSITY | e_N | 1 kHz | | 80 | | nV/ $\sqrt{\text{Hz}}$ |
| TURN ON SETTLING TIME | t_R | $C_L = 0 \mu\text{F}$ | | 10 | | μs |
| LONG-TERM STABILITY ¹ | ΔV_O | 1000 hours | | 40 | | ppm |
| OUTPUT VOLTAGE HYSTERESIS | V_{O_HYS} | | | 20 | | ppm |
| RIPPLE REJECTION RATIO | RRR | $f_{IN} = 1 \text{ kHz}$ | | -70 | | dB |
| SHORT CIRCUIT TO GND | I_{SC} | | | 40 | | mA |
| SUPPLY VOLTAGE OPERATING RANGE | V_{IN} | | 4.5 | | 18 | V |
| SUPPLY VOLTAGE HEADROOM | $V_{IN} - V_O$ | | 2 | | | V |

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

ADR434-EP ELECTRICAL CHARACTERISTICS

$V_{IN} = 6.1 \text{ V to } 18 \text{ V}$, $I_L = 0 \text{ mA}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 3.

| Parameter | Symbol | Test Conditions/Comments | Min | Typ | Max | Unit |
|----------------------------------|------------------------------|---|--------|-------|-------------------------|------------------------|
| OUTPUT VOLTAGE | V_O | | 4.0945 | 4.096 | 4.0975 | V |
| INITIAL ACCURACY | V_{OERR} | | | | ± 1.5 ± 0.04 | mV % |
| TEMPERATURE COEFFICIENT | TCV_O | $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 1 | 3 | ppm/ $^\circ\text{C}$ |
| LINE REGULATION | $\Delta V_O / \Delta V_{IN}$ | $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 5 | 20 | ppm/V |
| LOAD REGULATION | $\Delta V_O / \Delta I_L$ | $I_L = 0 \text{ mA to } 10 \text{ mA}$, $V_{IN} = 7 \text{ V}$, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ $I_L = -10 \text{ mA to } 0 \text{ mA}$, $V_{IN} = 7 \text{ V}$, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | | 15 15 | ppm/mA ppm/mA |
| QUIESCENT CURRENT | I_{IN} | No load, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 595 | 800 | μA |
| VOLTAGE NOISE | e_N p-p | 0.1 Hz to 10.0 Hz | | 6.25 | | $\mu\text{V p-p}$ |
| VOLTAGE NOISE DENSITY | e_N | 1 kHz | | 100 | | nV/ $\sqrt{\text{Hz}}$ |
| TURN ON SETTLING TIME | t_R | $C_L = 0 \mu\text{F}$ | | 10 | | μs |
| LONG-TERM STABILITY ¹ | ΔV_O | 1000 hours | | 40 | | ppm |
| OUTPUT VOLTAGE HYSTERESIS | V_{O_HYS} | | | 20 | | ppm |
| RIPPLE REJECTION RATIO | RRR | $f_{IN} = 1 \text{ kHz}$ | | -70 | | dB |
| SHORT CIRCUIT TO GND | I_{SC} | | | 40 | | mA |
| SUPPLY VOLTAGE OPERATING RANGE | V_{IN} | | 6.1 | | 18 | V |
| SUPPLY VOLTAGE HEADROOM | $V_{IN} - V_O$ | | 2 | | | V |

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

ADR435-EP ELECTRICAL CHARACTERISTICS

$V_{IN} = 7.0\text{ V to }18\text{ V}$, $I_L = 0\text{ mA}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 4.

| Parameter | Symbol | Test Conditions/Comments | Min | Typ | Max | Unit |
|----------------------------------|------------------------------|---|-------|-------|-------------------------|------------------------|
| OUTPUT VOLTAGE | V_O | | 4.998 | 5.000 | 5.002 | V |
| INITIAL ACCURACY | V_{OERR} | | | | ± 2.0 ± 0.04 | mV % |
| TEMPERATURE COEFFICIENT | TCV_O | $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 1 | 3 | ppm/ $^\circ\text{C}$ |
| LINE REGULATION | $\Delta V_O / \Delta V_{IN}$ | $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 5 | 20 | ppm/V |
| LOAD REGULATION | $\Delta V_O / \Delta I_L$ | $I_L = 0\text{ mA to }10\text{ mA}$, $V_{IN} = 8\text{ V}$, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ $I_L = -10\text{ mA to }0\text{ mA}$, $V_{IN} = 8\text{ V}$, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | | 15 15 | ppm/mA ppm/mA |
| QUIESCENT CURRENT | I_{IN} | No load, $-55^\circ\text{C} < T_A < +125^\circ\text{C}$ | | 620 | 800 | μA |
| VOLTAGE NOISE | e_N p-p | 0.1 Hz to 10.0 Hz | | 8 | | $\mu\text{V p-p}$ |
| VOLTAGE NOISE DENSITY | e_N | 1 kHz | | 115 | | nV/ $\sqrt{\text{Hz}}$ |
| TURN ON SETTLING TIME | t_R | $C_L = 0\ \mu\text{F}$ | | 10 | | μs |
| LONG-TERM STABILITY ¹ | ΔV_O | 1000 hours | | 40 | | ppm |
| OUTPUT VOLTAGE HYSTERESIS | V_{O_HYS} | | | 20 | | ppm |
| RIPPLE REJECTION RATIO | RRR | $f_{IN} = 1\text{ kHz}$ | | -70 | | dB |
| SHORT CIRCUIT TO GND | I_{SC} | | | 40 | | mA |
| SUPPLY VOLTAGE OPERATING RANGE | V_{IN} | | 7.0 | | 18 | V |
| SUPPLY VOLTAGE HEADROOM | $V_{IN} - V_O$ | | 2 | | | V |

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

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 5.

| Parameter | Rating |
|--------------------------------------|-----------------|
| Supply Voltage | 20 V |
| Output Short-Circuit Duration to GND | Indefinite |
| Storage Temperature Range | -65°C to +125°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 the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 6. Thermal Resistance

| Package Type | θ _{JA} | θ _{JC} | Unit |
|---------------------|-----------------|-----------------|------|
| 8-Lead SOIC_N (R-8) | 130 | 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.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS



NOTES

1. NIC = NOT INTERNALLY CONNECTED. THIS PIN IS NOT CONNECTED INTERNALLY.
2. DNC = DO NOT CONNECT. DO NOT CONNECT TO THIS PIN.

09218-101

Figure 2. Pin Configuration

Table 7. Pin Function Descriptions

| Pin No. | Mnemonic | Description |
|---------|------------------|--|
| 1, 8 | DNC | Do Not Connect. Do not connect to this pin. |
| 2 | V _{IN} | Input Voltage Connection. |
| 3 | NIC | Not Internally Connected. This pin is not connected internally. |
| 4 | GND | Ground. |
| 5 | TRIM | Output Voltage Trim. |
| 6 | V _{OUT} | Output Voltage. |
| 7 | COMP | Compensation Input. Connect a series resistor capacitor network from COMP to V _{OUT} to reduce overall noise. |

TYPICAL PERFORMANCE CHARACTERISTICS

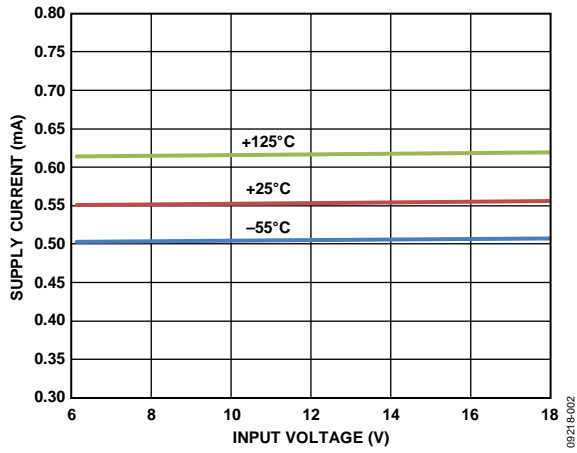
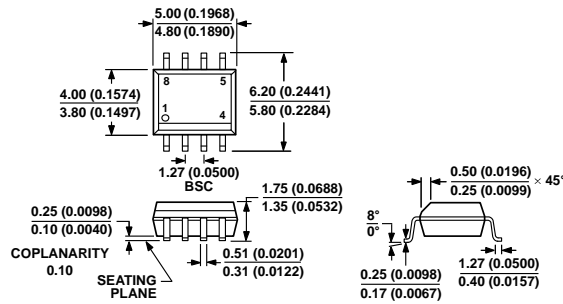


Figure 3. Supply Current vs. Input Voltage at Various Temperatures

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 4. 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 Coefficient Package (ppm/°C) | Temperature Range | Package Description | Package Option | Ordering Quantity |
|--------------------|--------------------|---------------------|------|--|-------------------|---------------------|----------------|-------------------|
| | | (mV) | (%) | | | | | |
| ADR431TRZ-EP | 2.500 | 1.0 | 0.04 | 5 | -55°C to +125°C | 8-Lead SOIC_N | R-8 | 98 |
| ADR431TRZ-EP-R7 | 2.500 | 1.0 | 0.04 | 5 | -55°C to +125°C | 8-Lead SOIC_N | R-8 | 1,000 |
| ADR434TRZ-EP | 4.096 | 1.5 | 0.04 | 3 | -55°C to +125°C | 8-Lead SOIC_N | R-8 | 98 |
| ADR434TRZ-EP-R7 | 4.096 | 1.5 | 0.04 | 3 | -55°C to +125°C | 8-Lead SOIC_N | R-8 | 1,000 |
| ADR435TRZ-EP | 5.000 | 2.0 | 0.04 | 3 | -55°C to +125°C | 8-Lead SOIC_N | R-8 | 98 |
| ADR435TRZ-EP-R7 | 5.000 | 2.0 | 0.04 | 3 | -55°C to +125°C | 8-Lead SOIC_N | R-8 | 1,000 |

¹ Z = RoHS Compliant Part.

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