# Low Power, Precision Reference and Op Amp

# ADR821/ADR827

## FEATURES

**10-lead MSOP**
**400 μA supply current**
**−40°C to +125°C temperature range**
**On-board precision resistors**
**Reference**
- **ADR821: 2.8 V to 15 V operation**
- **ADR827: 2.7 V to 15 V operation**
- **±0.2% initial accuracy**
- **15 ppm/°C temperature drift maximum**
- **+5 mA/−3 mA output drive**

**Amplifier**
- **ADR821**
  - **±2.8 V to ±15 V operation**
  - **2.8 V to 15 V single-supply operation**
- **ADR827**
  - **±2.7 V to ±15 V operation**
  - **2.7 V to 15 V single-supply operation**
- **Rail-to-rail input and output**
- **500 μV offset voltage maximum**
- **50 nA bias current maximum**
- **Unity gain stable**
- **No phase reversal**

## APPLICATIONS

**Battery-powered instrumentation**
**Portable medical instrumentation**
**Data acquisition systems**
**Industrial process controls**
**Automotive applications**

## FUNCTIONAL BLOCK DIAGRAM

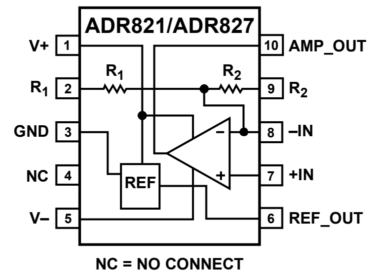


*Figure 1.*

Table 1. Selection Table

| Part No. | Reference $V_{OUT}$ | Reference Accuracy | Reference Temperature Coefficient |
|---|---|---|---|
| ADR827ARMZ | 1.25 V | ±0.4% | 30 ppm/°C |
| ADR827BRMZ | 1.25 V | ±0.2% | 15 ppm/°C |
| ADR821ARMZ | 2.50 V | ±0.4% | 30 ppm/°C |
| ADR821BRMZ | 2.50 V | ±0.2% | 15 ppm/°C |

## GENERAL DESCRIPTION

The ADR821/ADR827 combines a precision voltage reference and an op amp in a 10-lead mini small outline package (MSOP). The reference and the op amp can be operated independently, offering the user a range of flexibility when arranging the combination. Featuring a combined operating current of less than 400 μA and 15 ppm/°C temperature drift on the reference, the ADR821/ADR827 are ideally suited for applications requiring precision and low power.

Available with the reference at 1.25 V and at 2.5 V, the ADR821/ADR827 also come in two grades. The reference on the A grade offers 30 ppm/°C temperature drift performance and ±0.4% initial accuracy. The B grade provides a tighter temperature drift performance of 15 ppm/°C and only ±0.2% initial accuracy. All versions operate from −40°C to +125°C.

**Rev. 0**


**One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.**
**Tel: 781.329.4700** www.analog.com
**Fax: 781.461.3113**

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## REVISION HISTORY

**10/07—Revision 0: Initial Version**

# SPECIFICATIONS

## ADR821 ELECTRICAL CHARACTERISTICS—REFERENCE

$V_{IN}$ = 2.8 V to 15 V, $T_A$ = 25°C, $C_{IN}$ = $C_{OUT}$ = 0.1 μF, unless otherwise noted.

**Table 2.**

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| OUTPUT VOLTAGE | $V_{OUT}$ | | | | | |
| A Grade | | | 2.490 | 2.500 | 2.510 | V |
| B Grade | | | 2.495 | 2.500 | 2.505 | V |
| INITIAL ACCURACY | $V_{OERR}$ | | | | | |
| A Grade | | | | | 10 | mV |
| | | | | | 0.40 | % |
| B Grade | | | | | 5.00 | mV |
| | | | | | 0.20 | % |
| TEMPERATURE COEFFICIENT | $TCV_{OUT}$ | −40°C < $T_A$ < +125°C | | | | |
| A Grade | | | | | 30 | ppm/°C |
| B Grade | | | | | 15 | ppm/°C |
| DROPOUT ($V_{OUT}$ – $V_{IN}$) | $V_{DO}$ | $I_{OUT}$ = 0 mA | | | 0.3 | V |
| LINE REGULATION | $\Delta V_{OUT}/\Delta V_{IN}$ | $V_{IN}$ = 2.8 V to 15 V, −40°C < $T_A$ < +125°C | | 20 | 50 | ppm/V |
| LOAD REGULATION | $\Delta V_{OUT}/\Delta I_{LOAD}$ | $I_{LOAD}$ = 0 mA to 5 mA, −40°C < $T_A$ < +125°C, $V_{IN}$ = 5 V | | | 400 | ppm/mA |
| | | $I_{LOAD}$ = 0 mA to 5 mA, $V_{IN}$ = 5 V | | 80 | 200 | ppm/mA |
| | | $I_{LOAD}$ = −3 mA to 0 mA, −40°C < $T_A$ < +125°C, $V_{IN}$ = 5 V | | | 600 | ppm/mA |
| | | $I_{LOAD}$ = −3 mA to +5 mA, $V_{IN}$ = 5 V | | 80 | 300 | ppm/mA |
| VOLTAGE NOISE | $e_{N\ p\text{-}p}$ | 0.1 Hz to 10 Hz | | 16 | | μV p-p |
| BROADBAND NOISE | | 10 Hz to 10 kHz | | 430 | | μV p-p |
| TURN-ON SETTLING TIME | $t_R$ | $C_{IN}$ = 0 μF | | 80 | | μs |
| POWER SUPPLY | | | | | | |
| Positive Supply Current | $I_{SY+}$ | No load, −40°C < $T_A$ < +125°C | | | 400 | μA |
| Negative Supply Current | $I_{SY-}$ | No load, −40°C < $T_A$ < +125°C | | | 300 | μA |
| ON-BOARD RESISTORS | $R_1$, $R_2$ | | | | | |
| Resistor Tolerance | | | 8 | 10 | 12 | kΩ |
| Resistor Matching | | | | 0.5 | | % |
| Resistor Temperature Coefficient | TC | | | ±100 | | ppm/°C |

## ADR821 ELECTRICAL CHARACTERISTICS—AMPLIFIER ($V_S$ = ±2.8 V)

$V_{CM}$ = 0 V, $T_A$ = 25°C, unless otherwise noted.

**Table 3.**

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Input Offset Voltage | $V_{OS}$ | −40°C < $T_A$ < +125°C | | 100 | 500 | µV |
| Input Offset Voltage Drift | $TCV_{OS}$ | −40°C < $T_A$ < +125°C | | 2 | 5 | µV/°C |
| Input Bias Current | $I_B$ | −40°C < $T_A$ < +125°C | | 15 | 50 | nA |
| Input Offset Bias Current | $I_{OS}$ | −40°C < $T_A$ < +125°C | | 5 | 25 | nA |
| Large Signal Voltage Gain | $A_{VO}$ | $V_{OUT}$ = −1.5 V to +1.5 V | | | | |
| | | $R_{LOAD}$ = 10 kΩ, −40°C < $T_A$ < +125°C | 99 | 108 | | dB |
| | | $R_{LOAD}$ = 2 kΩ, −40°C < $T_A$ < +125°C | 94 | 100 | | dB |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = −1.5 V to +1.5 V, −40°C < $T_A$ < +125°C | 75 | 100 | | dB |
| | | | 85 | | | dB |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $I_{LOAD}$ = 1 mA | 2.6 | 2.7 | | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | 2.55 | | | V |
| Output Voltage Low | $V_{OL}$ | $I_{LOAD}$ = 1 mA | | −2.7 | −2.6 | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | | | −2.55 | V |
| POWER SUPPLY | | | | | | |
| Positive Supply Current | $I_{SY+}$ | No load, −40°C < $T_A$ < +125°C | | | 400 | µA |
| Negative Supply Current | $I_{SY-}$ | No load, −40°C < $T_A$ < +125°C | | | 300 | µA |
| Power Supply Rejection Ratio | PSRR | $V_S$ = ±2.8 V to ±15 V | 75 | 100 | | dB |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_{LOAD}$ = 10 kΩ, $C_{LOAD}$ = 10 pF, $A_V$ = +1 | | 0.5 | | V/µs |
| Gain Bandwidth Product | GBP | $C_{LOAD}$ = 14 pF | | 1.0 | | MHz |
| Phase Margin | $φ_M$ | $C_{LOAD}$ = 14 pF | | 72.5 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{N\ p\text{-}p}$ | f = 0.1 Hz to 10 Hz | | 0.2 | | µV p-p |
| Voltage Noise Density | $e_N$ | f = 1 kHz | | 16 | | nV/√Hz |

## ADR821 ELECTRICAL CHARACTERISTICS—AMPLIFIER ($V_S$ = ±15 V)

$V_{CM}$= 0 V, $T_A$ = 25°C, unless otherwise noted.

**Table 4.A**

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Input Offset Voltage | $V_{OS}$ | −40°C < $T_A$ < +125°C | | 100 | 500 | µV |
| Input Offset Voltage Drift | $TCV_{OS}$ | −40°C < $T_A$ < +125°C | | 2 | 5 | µV/°C |
| Input Bias Current | $I_B$ | −40°C < $T_A$ < +125°C | | 10 | 50 | nA |
| Input Offset Bias Current | $I_{OS}$ | −40°C < $T_A$ < +125°C | | 5 | 25 | nA |
| Large Signal Voltage Gain | $A_{VO}$ | $V_{OUT}$ = −14 V to +14 V | | | | |
| | | $R_{LOAD}$ = 10 kΩ, −40°C < $T_A$ < +125°C | 109.5 | 118 | | dB |
| | | $R_{LOAD}$ = 2 kΩ, −40°C < $T_A$ < +125°C | 100 | 111 | | dB |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = −14 V to +14 V, −40°C < $T_A$ < +125°C | 75 | 100 | | dB |
| | | | 85 | | | dB |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage high | $V_{OH}$ | $I_{LOAD}$ = 1 mA | 14.8 | 14.9 | | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | 14.75 | | | V |
| Output Voltage Low | $V_{OL}$ | $I_{LOAD}$ = 1 mA | | −14.9 | −14.8 | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | | | −14.75 | V |
| Output Current | $I_{SC}$ | Short-circuit current | | ±20 | | mA |
| POWER SUPPLY | | | | | | |
| Positive Supply Current | $I_{SY+}$ | No load, −40°C < $T_A$ < +125°C | | | 400 | µA |
| Negative Supply Current | $I_{SY-}$ | No load, −40°C < $T_A$ < +125°C | | | 300 | µA |
| Power Supply Rejection Ratio | PSRR | $V_S$ = ±2.8 V to ±15 V | 75 | 100 | | dB |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_{LOAD}$ = 10 kΩ, $C_{LOAD}$ = 10 pF, $A_V$ = +1 | | 0.5 | | V/µs |
| Gain Bandwidth Product | GBP | $C_{LOAD}$ = 14 pF | | 1.0 | | MHz |
| Phase Margin | $φ_M$ | $C_{LOAD}$ = 14 pF | | 75.4 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{N\ p\text{-}p}$ | f = 0.1 Hz to 10 Hz | | 0.2 | | µV p-p |
| Voltage Noise Density | $e_N$ | f = 1 kHz | | 16 | | nV/√Hz |

## ADR827 ELECTRICAL CHARACTERISTICS—REFERENCE

$V_{IN}$ = 2.7 V to 15 V, $T_A$ = 25°C, $C_{IN}$ = $C_{OUT}$ = 0.1 µF, unless otherwise noted.

**Table 5.**

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| OUTPUT VOLTAGE | $V_{OUT}$ | | | | | |
| A Grade | | | 1.245 | 1.250 | 1.255 | V |
| B Grade | | | 1.2475 | 1.250 | 1.2525 | V |
| INITIAL ACCURACY | $V_{OERR}$ | | | | | |
| A Grade | | | | | 5 | mV |
| | | | | | 0.40 | % |
| B Grade | | | | | 2.50 | mV |
| | | | | | 0.20 | % |
| TEMPERATURE COEFFICIENT | $TCV_{OUT}$ | −40°C < $T_A$ < +125°C | | | | |
| A Grade | | | | | 30 | ppm/°C |
| B Grade | | | | | 15 | ppm/°C |
| DROPOUT ($V_{OUT}$ – $V_{IN}$) | $V_{DO}$ | $I_{OUT}$ = 0 mA | | | 1.45 | V |
| LINE REGULATION | $\Delta V_{OUT}/\Delta V_{IN}$ | $V_{IN}$ = 2.7 V to 15 V, −40°C < $T_A$ < +125°C | | 20 | 50 | ppm/V |
| LOAD REGULATION | $\Delta V_{OUT}/\Delta I_{LOAD}$ | $I_{LOAD}$ = 0 mA to 5 mA, −40°C < $T_A$ < +125°C, $V_{IN}$ = 3 V | | | 400 | ppm/mA |
| | | $I_{LOAD}$ = 0 mA to 5 mA, $V_{IN}$ = 3 V | | 80 | 200 | ppm/mA |
| | | $I_{LOAD}$ = −3 mA to 0 mA, −40°C < $T_A$ < +125°C, $V_{IN}$ = 3 V | | | 600 | ppm/mA |
| | | $I_{LOAD}$ = −3 mA to +5 mA, $V_{IN}$ = 3 V | | 80 | 300 | ppm/mA |
| VOLTAGE NOISE | $e_{N\ p\text{-}p}$ | 0.1 Hz to 10 Hz | | 8 | | µV p-p |
| BROADBAND NOISE | | 10 Hz to 10 kHz | | 260 | | µV p-p |
| TURN-ON SETTLING TIME | $t_R$ | $C_{IN}$ = 0 µF, $C_{OUT}$ = 0.1 µF | | 80 | | µs |
| POWER SUPPLY | | | | | | |
| Positive Supply Current | $I_{SY+}$ | No load, −40°C < $T_A$ < +125°C | | | 400 | µA |
| Negative Supply Current | $I_{SY-}$ | No load, −40°C < $T_A$ < +125°C | | | 300 | µA |
| ON-BOARD RESISTORS | $R_1$, $R_2$ | | | | | |
| Resistor Tolerance | | | 8 | 10 | 12 | kΩ |
| Resistor Matching | | | | 0.5 | | % |
| Resistor Temperature Coefficient | TC | | | ±100 | | ppm/°C |

## ADR827 ELECTRICAL CHARACTERISTICS—AMPLIFIER ($V_S$ = ±2.7 V)

$V_{CM}$ = 0 V, $T_A$ = 25°C, unless otherwise noted.

**Table 6.**

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Input Offset Voltage | $V_{OS}$ | −40°C < $T_A$ < +125°C | | 100 | 500 | µV |
| Input Offset Voltage Drift | $TCV_{OS}$ | −40°C < $T_A$ < +125°C | | 2 | 5 | µV/°C |
| Input Bias Current | $I_B$ | −40°C < $T_A$ < +125°C | | 15 | 50 | nA |
| Input Offset Bias Current | $I_{OS}$ | −40°C < $T_A$ < +125°C | | 5 | 25 | nA |
| Large Signal Voltage Gain | $A_{VO}$ | $V_{OUT}$ = −1.5 V to +1.5 V | | | | |
| | | $R_{LOAD}$ = 10 kΩ, −40°C < $T_A$ < +125°C | 99 | 108 | | dB |
| | | $R_{LOAD}$ = 2 kΩ, −40°C < $T_A$ < +125°C | 94 | 100 | | dB |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = −1.5 V to +1.5 V, −40°C < $T_A$ < +125°C | 75 | 100 | | dB |
| | | | 85 | | | dB |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $I_{LOAD}$ = 1 mA | 2.5 | 2.6 | | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | 2.45 | | | V |
| Output Voltage Low | $V_{OL}$ | $I_{LOAD}$ = 1 mA | | −2.6 | −2.5 | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | | | −2.45 | V |
| POWER SUPPLY | | | | | | |
| Positive Supply Current | $I_{SY+}$ | No load, −40°C < $T_A$ < +125°C | | | 400 | µA |
| Negative Supply Current | $I_{SY-}$ | No load, −40°C < $T_A$ < +125°C | | | 300 | µA |
| Power Supply Rejection Ratio | PSRR | $V_S$ = ±2.7 V to ±15 V | 75 | 100 | | dB |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_{LOAD}$ = 10 kΩ, $C_{LOAD}$ = 10 pF, $A_V$ = +1 | | 0.5 | | V/µs |
| Gain Bandwidth Product | GBP | $C_{LOAD}$ = 14 pF | | 1.0 | | MHz |
| Phase Margin | $φ_M$ | $C_{LOAD}$ = 14 pF | | 71.3 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{N\ p\text{-}p}$ | f = 0.1 Hz to 10 Hz | | 0.2 | | µV p-p |
| Voltage Noise Density | $e_N$ | f = 1 kHz | | 16 | | nV/√Hz |

## ADR827 ELECTRICAL CHARACTERISTICS—AMPLIFIER ($V_S$ = ±15 V)

$V_{CM}$ = 0 V, $T_A$ = 25°C, unless otherwise noted.

**Table 7.**

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Input Offset Voltage | $V_{OS}$ | −40°C < $T_A$ < +125°C | | 100 | 500 | µV |
| Input Offset Voltage Drift | $TCV_{OS}$ | −40°C < $T_A$ < +125°C | | 2 | 5 | µV/°C |
| Input Bias Current | $I_B$ | −40°C < $T_A$ < +125°C | | 10 | 50 | nA |
| Input Offset Bias Current | $I_{OS}$ | −40°C < $T_A$ < +125°C | | 5 | 25 | nA |
| Large Signal Voltage Gain | $A_{VO}$ | $V_{OUT}$ = −14 V to +14 V | | | | |
| | | $R_{LOAD}$ = 10 kΩ, −40°C < $T_A$ < +125°C | 109.5 | 118 | | dB |
| | | $R_{LOAD}$ = 2 kΩ, −40°C < $T_A$ < +125°C | 100 | 111 | | dB |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = −14 V to +14 V, −40°C < $T_A$ < 125°C | 75 | 100 | | dB |
| | | | 85 | | | dB |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $I_{LOAD}$ = 1 mA | 14.8 | 14.9 | | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | 14.75 | | | V |
| Output Voltage Low | $V_{OL}$ | $I_{LOAD}$ = 1 mA | | −14.9 | −14.8 | V |
| | | $I_{LOAD}$ = 1 mA, −40°C < $T_A$ < +125°C | | | −14.75 | V |
| Output Current | $I_{SC}$ | Short-circuit current | | ±20 | | mA |
| POWER SUPPLY | | | | | | |
| Positive Supply Current | $I_{SY+}$ | No load, −40°C < $T_A$ < +125°C | | | 400 | µA |
| Negative Supply Current | $I_{SY-}$ | No load, −40°C < $T_A$ < +125°C | | | 300 | µA |
| Power Supply Rejection Ratio | PSRR | $V_S$ = ±2.7 V to ±15 V | 75 | 100 | | dB |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_{LOAD}$ = 10 kΩ, $C_{LOAD}$ = 10 pF, $A_V$ = +1 | | 0.5 | | V/µs |
| Gain Bandwidth Product | GBP | $C_{LOAD}$ = 14 pF | | 1.0 | | MHz |
| Phase Margin | $\varphi_M$ | $C_{LOAD}$ = 14 pF | | 75.4 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{N\ p\text{-}p}$ | f = 0.1 Hz to 10 Hz | | 0.2 | | µV p-p |
| Voltage Noise Density | $e_N$ | f = 1 kHz | | 16 | | nV/√Hz |

# ABSOLUTE MAXIMUM RATINGS

$T_A$= 25°C, unless otherwise noted.

**Table 8.**

| Parameter | Rating |
|---|---|
| Supply Voltage | ±18 V |
| Output Short-Circuit Duration to GND | Indefinite |
| Storage Temperature Range | –65°C to +125°C |
| Operating Temperature Range | –40°C to +125°C |
| Junction Temperature Range | –65°C to +125°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.

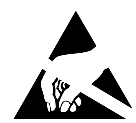
## THERMAL RESISTANCE

$\theta_{JA}$ is specified for the worst-case conditions, that is, $\theta_{JA}$ is specified for device soldered in circuit board for surface-mount packages.

**Table 9. Thermal Resistance**

| Package Type | $\theta_{JA}$ | $\theta_{JC}$ | Unit |
|---|---|---|---|
| 10-Lead MSOP (RM-10) | 172 | 50 | °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

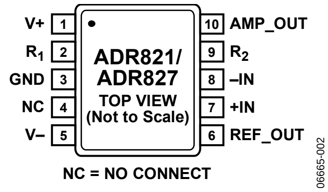



*Figure 2. Pin Configuration*

**Table 10. Pin Function Descriptions**

| Pin No. | Mnemonic | Description |
|---|---|---|
| 1 | V+ | Input Voltage of the Reference/Positive Supply of the Amplifier |
| 2 | $R_1$ | Resistance Tied to Positive Input of the Amplifier |
| 3 | GND | Ground |
| 4 | NC | Do Not Connect Any External Components to This Pin |
| 5 | V– | Negative Supply of the Amplifier |
| 6 | REF_OUT | Output Voltage of the Reference |
| 7 | +IN | Positive Input of the Amplifier |
| 8 | –IN | Negative Input of the Amplifier |
| 9 | $R_2$ | Resistance Tied to Positive Input of the Amplifier |
| 10 | AMP_OUT | Output Pin of the Amplifier |

# TYPICAL PERFORMANCE CHARACTERISTICS

## REFERENCE

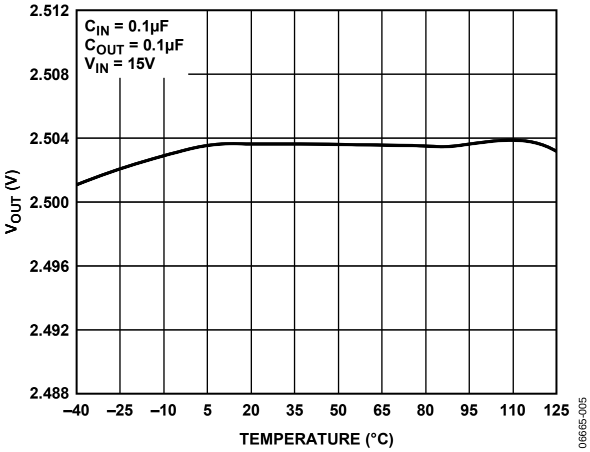



Figure 3. ADR821 $V_{OUT}$ vs. Temperature

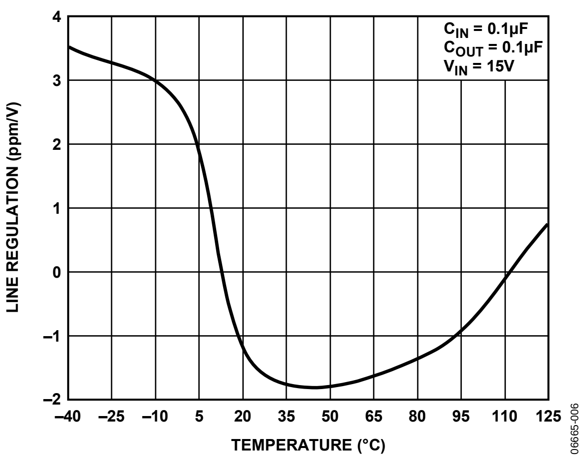



Figure 4. ADR821 Line Regulation vs. Temperature

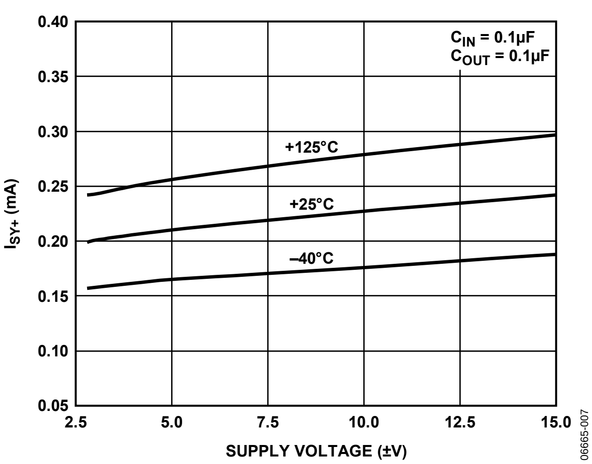



Figure 5. ADR821 Supply Current (+) vs. Supply Voltage

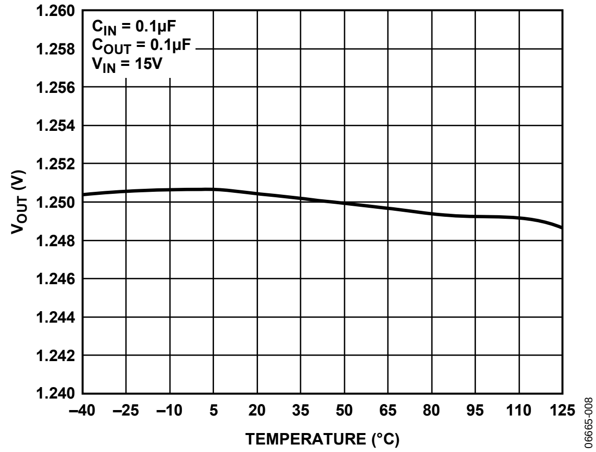



Figure 6. ADR827 $V_{OUT}$ vs. Temperature

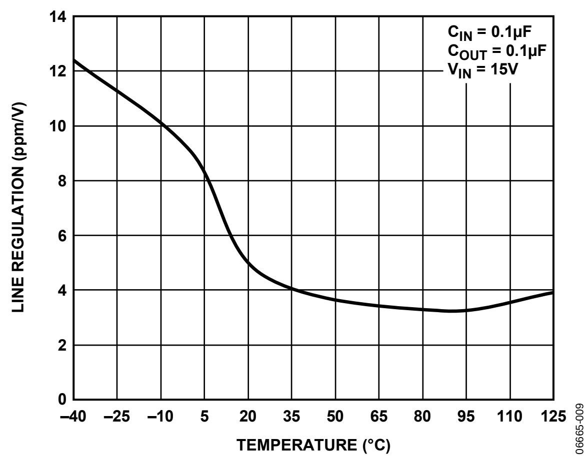



Figure 7. ADR827 Line Regulation vs. Temperature

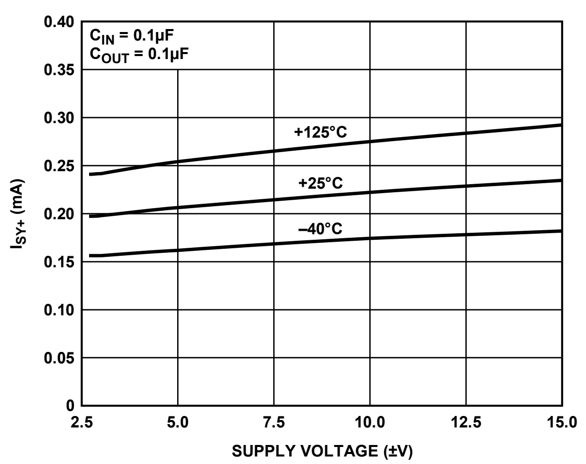



Figure 8. ADR827 Supply Current (+) vs. Supply Voltage

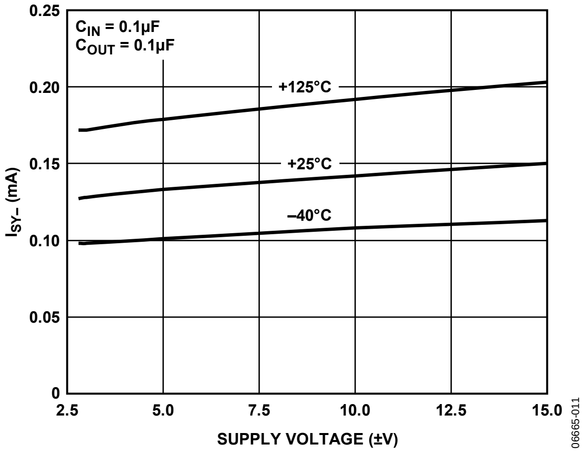



*Figure 9. ADR821 Supply Current (–) vs. Supply Voltage*

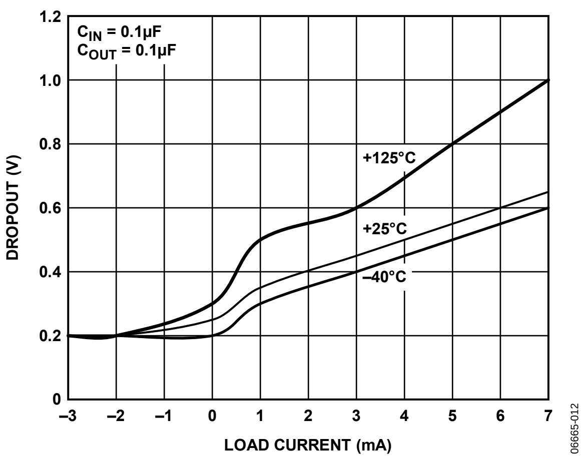



*Figure 10. ADR821 Dropout vs. Load Current*

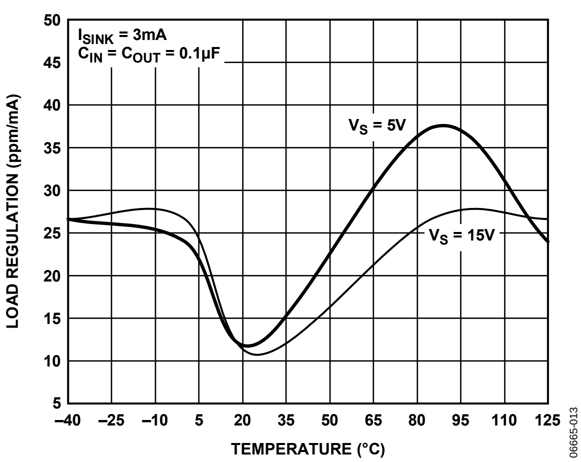



*Figure 11. ADR821 Load Regulation vs. Temperature*

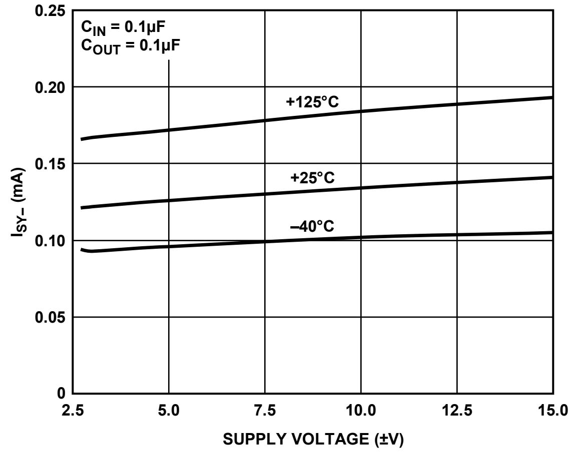



*Figure 12. ADR827 Supply Current (–) vs. Supply Voltage*

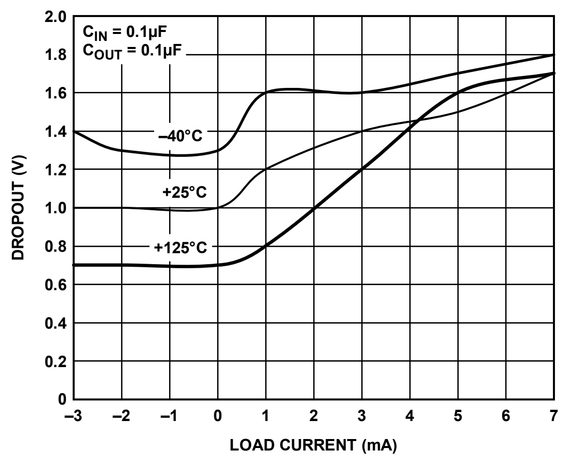



*Figure 13. ADR827 Dropout vs. Load Current*

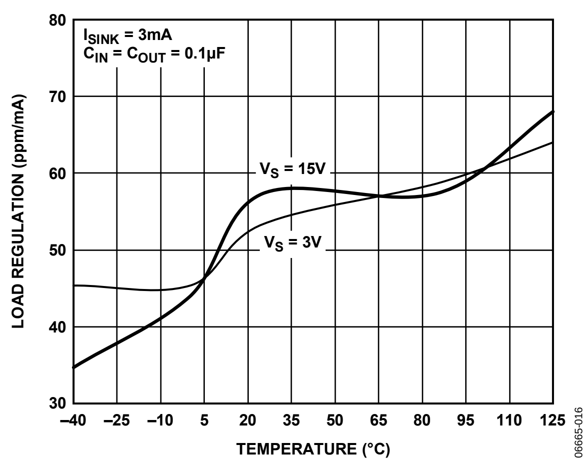



*Figure 14. ADR827 Load Regulation vs. Temperature*

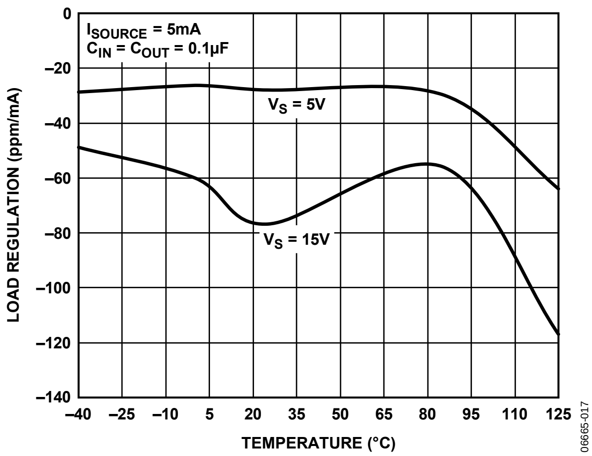



Figure 15. ADR821 Load Regulation vs. Temperature

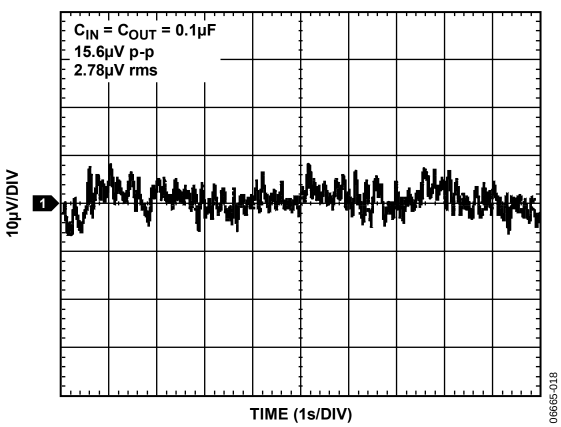



Figure 16. ADR821 0.1 Hz to 10 Hz Noise

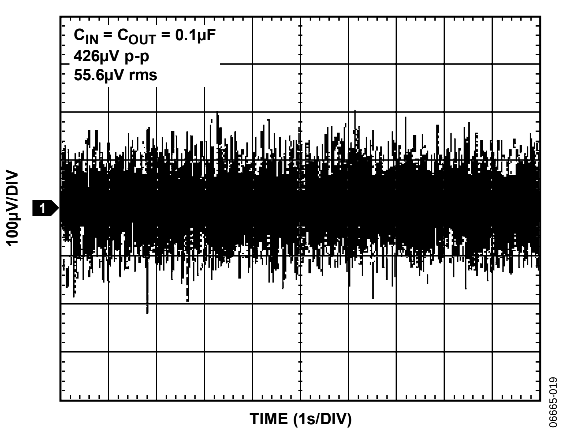



Figure 17. ADR821 10 Hz to 10 kHz Noise

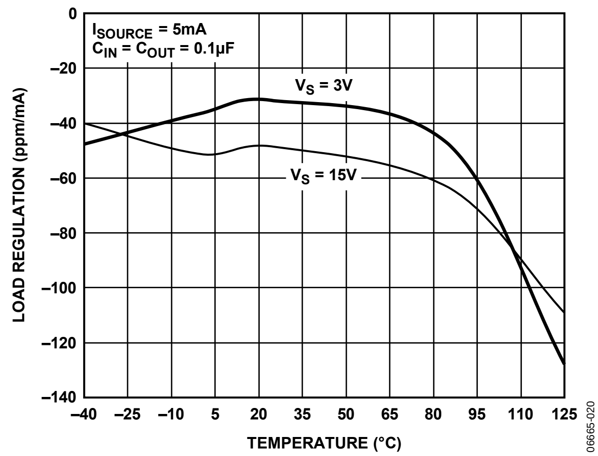



Figure 18. ADR827 Load Regulation vs. Temperature

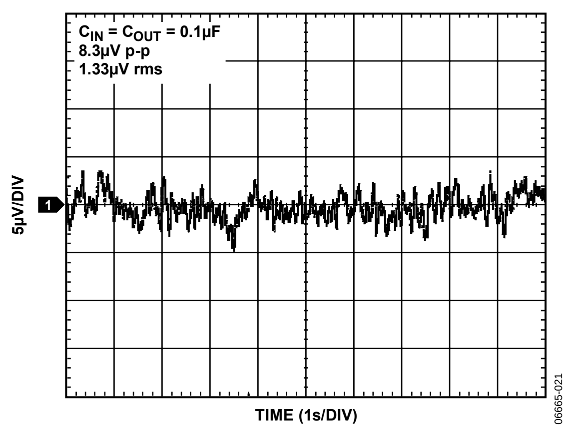



Figure 19. ADR827 0.1 Hz to 10 Hz Noise

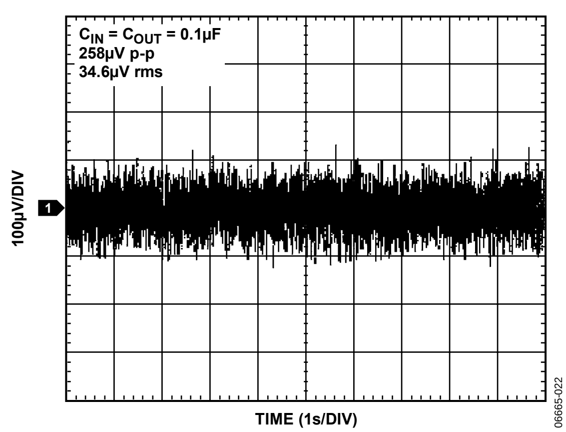



Figure 20. ADR827 10 Hz to 10 kHz Noise

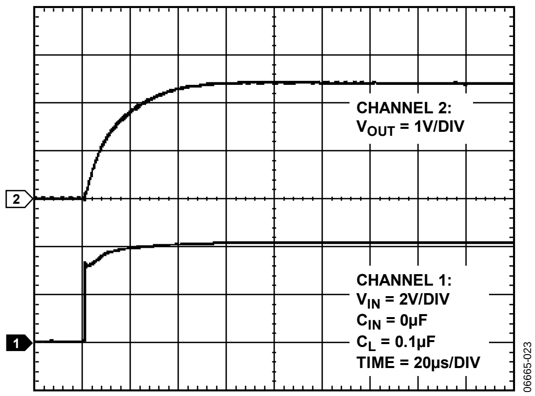



*Figure 21. ADR821 Turn-On Response*

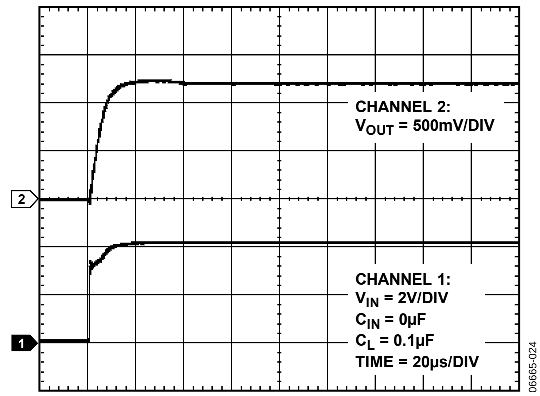



*Figure 22. ADR827 Turn-On Response*

## AMPLIFIER (AD821/AD827)

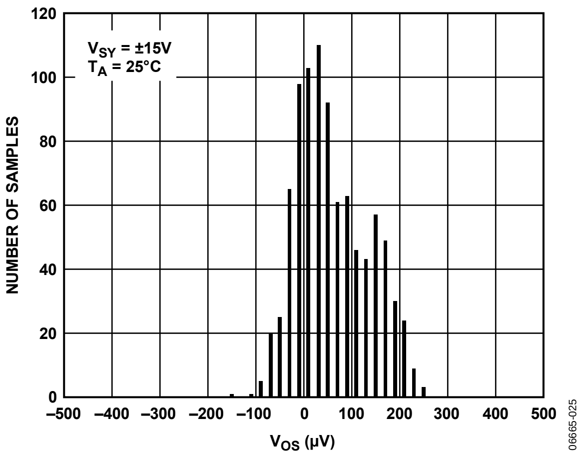



Figure 23. Input Offset Voltage Distribution

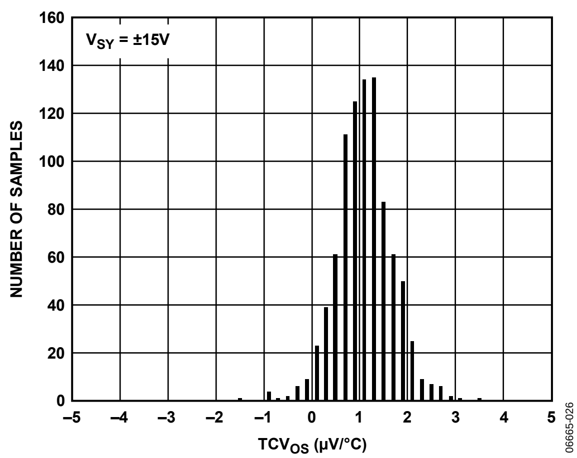



Figure 24. Offset Voltage Drift Distribution

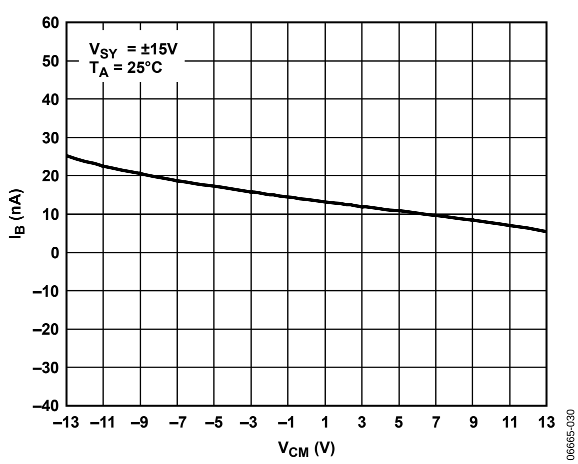



Figure 25. Input Bias Current vs. Common-Mode Voltage

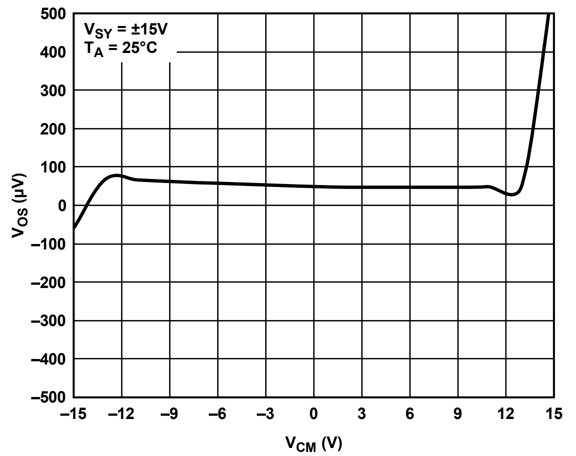



Figure 26. Input Offset Voltage vs. Common-Mode Voltage

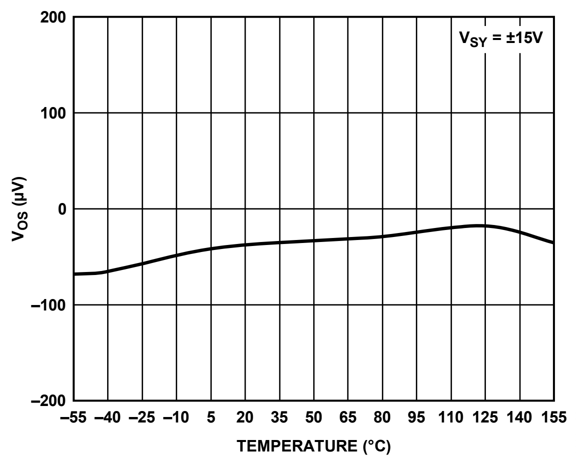



Figure 27. Input Offset Voltage vs. Temperature

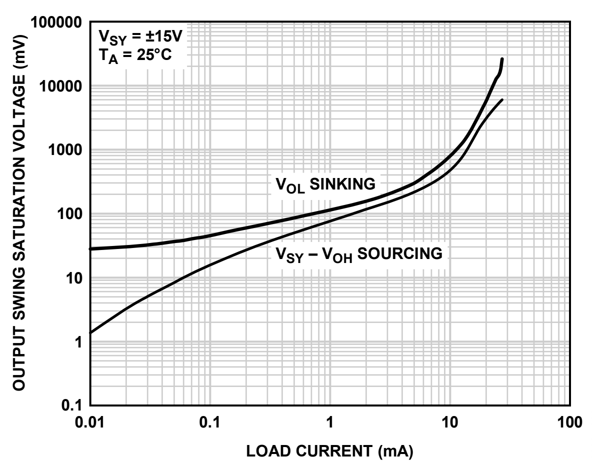



Figure 28. Output Swing Saturation Voltage vs. Load Current

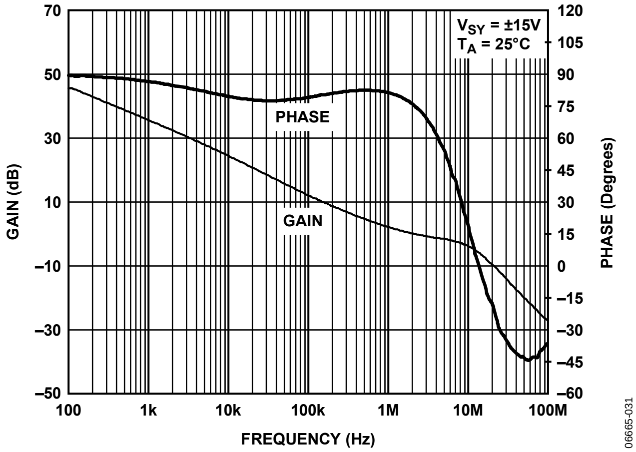



Figure 29. Open-Loop Gain and Phase vs. Frequency

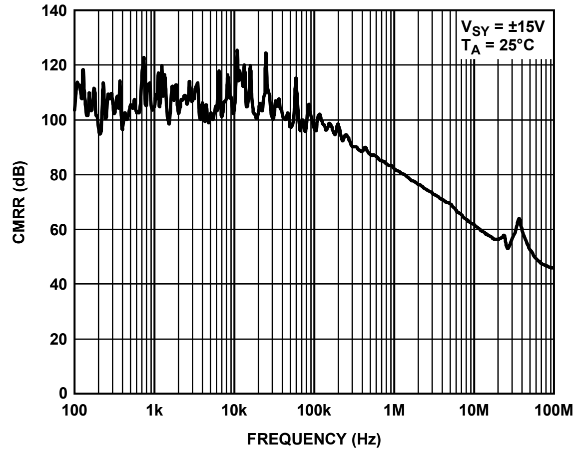



Figure 32. CMRR vs. Frequency

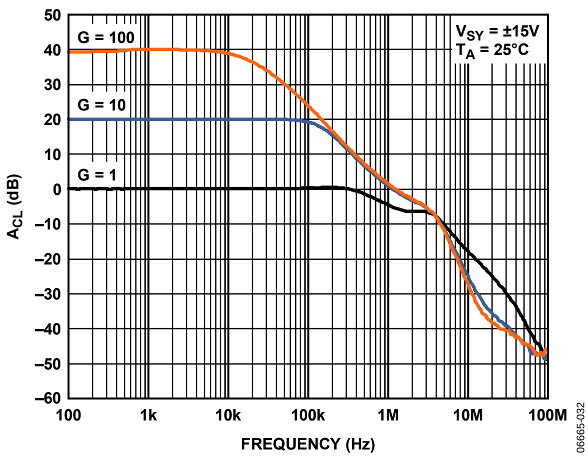



Figure 30. Closed-Loop Gain vs. Frequency

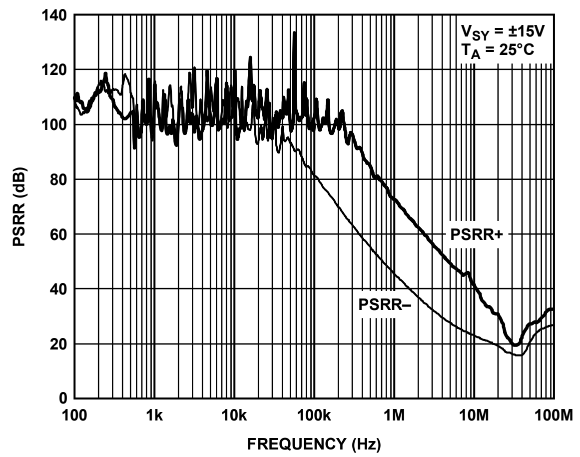



Figure 33. PSRR vs. Frequency

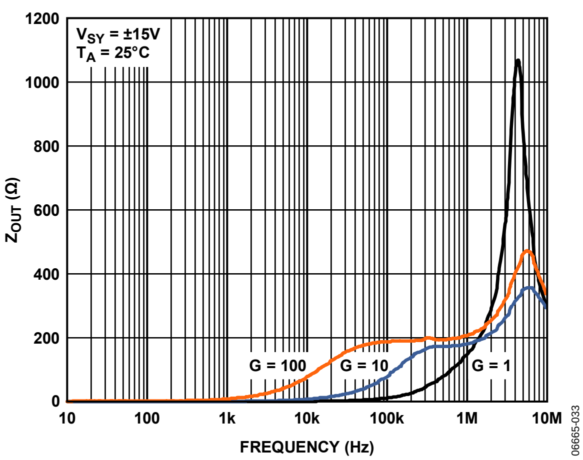



Figure 31. $Z_{OUT}$ vs. Frequency

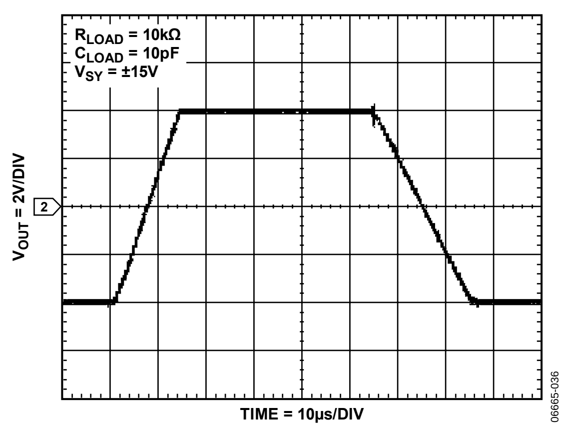



Figure 34. Large Signal Transient Response

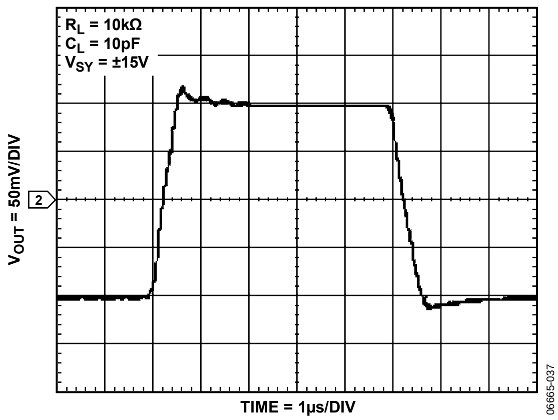



*Figure 35. Small Signal Transient Response, $C_L$ = 10 pF*

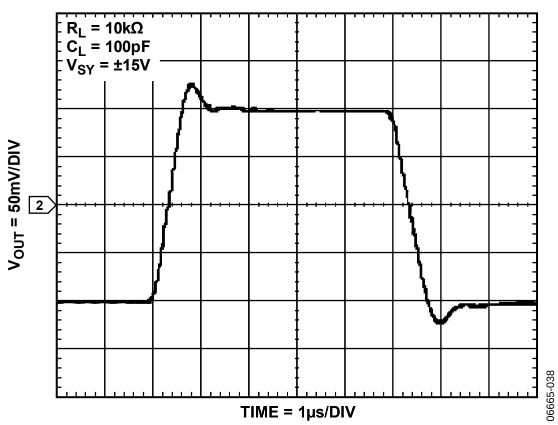



*Figure 36. Small Signal Transient Response, $C_L$ = 100 pF*

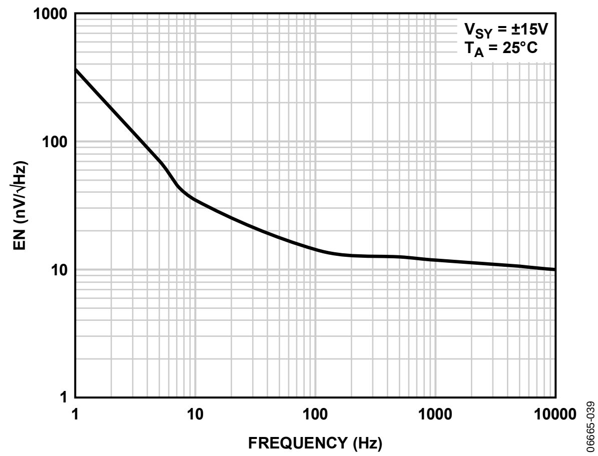



*Figure 37. Voltage Noise Density*

# APPLICATIONS INFORMATION

## +2.5 V AND −2.5 V OUTPUTS (ADR821)

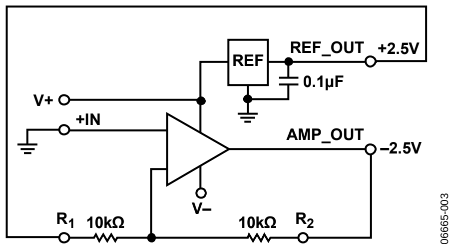



*Figure 38. +2.5 V and −2.5 V Outputs*

In many dual-supply applications, it is desirable to have ±2.5 V references. Using the configuration shown in Figure 38, it is possible to generate −2.5 V with the help of a +2.5 V reference, an internal op amp, and 10 kΩ resistors. The supply voltages V+ and V− should be greater than +2.8 V and −2.8 V, respectively. The op amp is configured as an inverting amplifier with a gain of −1, which produces −2.5 V at the output of the op amp. The output of the reference is fed to the amplifier inverting input. Because the op amp has very low input offset voltage (500 µV over the full temperature range) and the TC ratio of the resistors is typically ±25 ppm/°C, the −2.5 V output is less than 7 mV away from the theoretical value.

## 2.5 V AND 5.0 V OUTPUTS (ADR821)

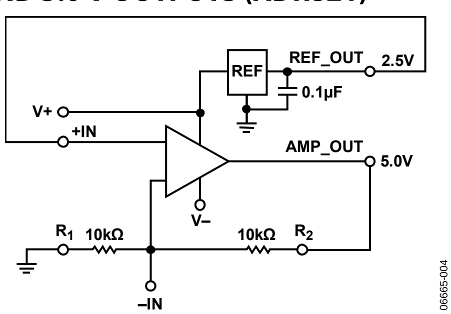



*Figure 39. 2.5 V and 5.0 V Outputs*

In many single-supply applications, it is desirable to have multiple reference voltages. Using the configuration shown in Figure 39, it is possible to generate 5.0 V with the help of a 2.5 V reference, an internal op amp, and resistors. V+ should be kept at greater than 5.8 V and V− can be connected either to ground or to negative supply. The output of the reference is fed to the amplifier noninverting input. The op amp is configured as a noninverting amplifier with a gain of +2, which produces 5 V at the output of the op amp. Using the guaranteed maximum offset voltage over the temperature, and the typical TC ratio of the resistors over the full temperature range, the output is within 15 mV of the calculated value.

## MULTIPLE 2.5 V OUTPUTS (ADR821)

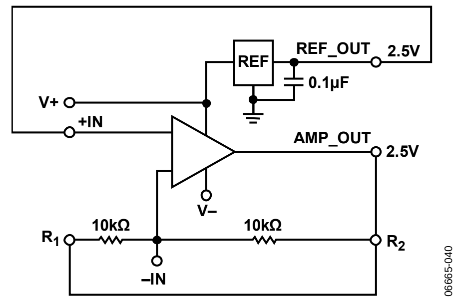



*Figure 40. Multiple 2.5 V Outputs*

On some boards, sensitive analog circuits, such as a VCO, exist with noisy digital circuits. If the supply current requirements are low (less than 3 mA), series references and op amps can be used. Using the configuration shown in Figure 40, two different 2.5 V supplies can be created using a single ADR821. The supply voltage V+ should be greater than 2.8 V and V− can be connected to ground or a negative voltage. The op amp is configured as a voltage follower with a gain of +1, which produces 2.5 V at the output of the op amp. The output of the reference is fed to the amplifier noninverting input. Because the op amp has very low input offset voltage (500 µV maximum over the full temperature range), the output voltage from the op amp section tracks the reference voltage within 1 mV. For a dynamic load, such as the reference input pin on some analog-to-digital converters, the load should be connected to an op amp output and the noise sensitive circuitry, such as a VCO, should be connected to the reference output. If the dynamic load is connected to the reference voltage, any perturbations appear as a signal to the input of the voltage follower and appear on the other output.

# OUTLINE DIMENSIONS

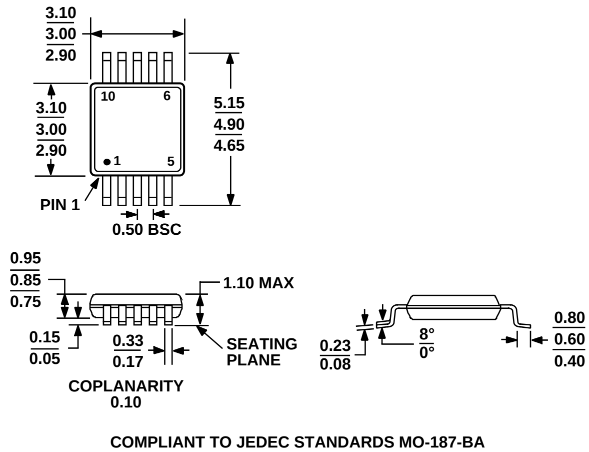



*Figure 41. 10-Lead Mini Small Outline Package [MSOP]*
*(RM-10)*
*Dimensions shown in millimeters*

## ORDERING GUIDE

| Models | Temperature Range | Output Voltage ($V_{OUT}$) | Initial Accuracy (mV) | Initial Accuracy (%) | Temperature Coefficient (ppm/°C) | Package Description | Package Option | Ordering Quantity | Branding |
|---|---|---|---|---|---|---|---|---|---|
| ADR821ARMZ-REEL7[1] | −40°C to +125°C | 2.500 | 10.00 | ±0.40 | 30 | 10-Lead MSOP | RM-10 | 1,000 | R2G |
| ADR821ARMZ-R2[1] | −40°C to +125°C | 2.500 | 10.00 | ±0.40 | 30 | 10-Lead MSOP | RM-10 | 250 | R2G |
| ADR821BRMZ-REEL7[1] | −40°C to +125°C | 2.500 | 5.00 | ±0.20 | 15 | 10-Lead MSOP | RM-10 | 1,000 | R2H |
| ADR821BRMZ-R2[1] | −40°C to +125°C | 2.500 | 5.00 | ±0.20 | 15 | 10-Lead MSOP | RM-10 | 250 | R2H |
| ADR827ARMZ-REEL7[1] | −40°C to +125°C | 1.250 | 5.00 | ±0.40 | 30 | 10-Lead MSOP | RM-10 | 1,000 | R0Z |
| ADR827ARMZ-R2[1] | −40°C to +125°C | 1.250 | 5.00 | ±0.40 | 30 | 10-Lead MSOP | RM-10 | 250 | R0Z |
| ADR827BRMZ-REEL7[1] | −40°C to +125°C | 1.250 | 2.50 | ±0.20 | 15 | 10-Lead MSOP | RM-10 | 1,000 | R2B |
| ADR827BRMZ-R2[1] | −40°C to +125°C | 1.250 | 2.50 | ±0.20 | 15 | 10-Lead MSOP | RM-10 | 250 | R2B |

[1] Z = RoHS Compliant Part.

## NOTES


D06665-0-10/07(0)

ANALOG DEVICES

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