**Dual, 30V Precision, Rail-to-Rail I/O Low Power Operational Amplifier**

Preliminary Technical Data

# ADA4084-2

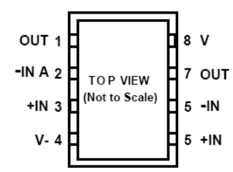
## FEATURES

**Rail-to-Rail Input/Output**
**Low Power: 650 µA typ**
**Wide bandwidth: 8.3 MHz Unity Gain Bandwidth**
**Low offset voltage: 100 µV max @ 25°C**
**Unity-gain stable**
**High slew rate: 4.0 V/µs typ**
**Low noise: 3.9 nV/√Hz typ**

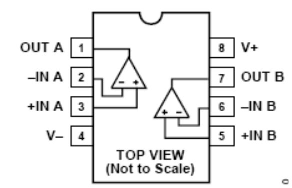
## APPLICATIONS

**Battery-powered instrumentation**
**Power supply control and protection**
**Telecom**
**DAC output amplifier**
**ADC input buffer**

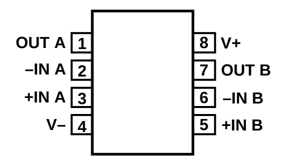
## PIN CONFIGURATIONS




8-Lead LFCSP (CP)




8-Lead MSOP (RM-8)




8-Lead LFCSP (CP)

## GENERAL DESCRIPTION

ADA4084-2 is a dual amplifier featuring 650µA per amplifier with single-supply operation, 8.3 MHz bandwidth, and rail-to-rail inputs and outputs. They are guaranteed to operate from 3 V to 30 V single supplies or ±1.5 V to ±15 V dual supplies.

These amplifiers are superb for single-supply and dual applications requiring both AC and precision DC performance with input voltage range and output swings very close to the power supply rails. The combination of bandwidth, low noise, low power, and precision makes the ADA4084 useful in a wide variety of applications, including filters and instrumentation.

Other applications for these amplifiers include portable telecom equipment, power supply control and protection, and as amplifiers or buffers for transducers with wide output ranges. Sensors requiring a rail-to-rail input amplifier include Hall Effect, piezoelectric, and resistive transducers.

The ability to swing rail-to-rail at both the input and output enables designers to build multistage filters in single-supply systems and to maintain high signal-to-noise ratios.

The ADA4084-2 is specified over the extended industrial temperature range of –40°C to +125°C. The ADA4084-2 is a dual available in 8-lead LFCSP (3x3mm), SOIC, and MSOP packages.

**Table 1. 30V Rail-to-Rail I/O Op Amps**

| | Precision | Precision Low Power | Low Power |
|---|---|---|---|
| Single | OP184 | | |
| Dual | OP284 | ADA4091-2 | ADA4092-2 |
| Quad | OP484 | ADA4091-4 | ADA4092-4 |

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# SPECIFICATIONS

## ELECTRICAL CHARACTERISTICS – VS = ±15V

$V_S$ = ±15 V @ $T_A$ = 25°C, $V_{CM}$ = 0 V, $V_{OUT}$ = 0 V, unless otherwise noted.

Table 2.

| Parameter | Symbol | Test Conditions / Comments | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Voltage Offset | $V_{OS}$ | | | | 100 | µV |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | 300 | µV |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | −40 ºC ≤ $T_A$ ≤ +125°C | | 0.2 | | µV/°C |
| Input Bias Current | $I_B$ | | | 80 | 450 | nA |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | 575 | nA |
| Bias Current Drift | $\Delta I_B/\Delta T$ | | | 150 | | pA/°C |
| Input Offset Current | $I_{OS}$ | | | | 50 | nA |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | nA |
| Input Voltage Range | | | -15 | | +15 | V |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = ±14 V, −40 ºC ≤ $T_A$ ≤ +125°C | 86 | 90 | | dB |
| | | $V_{CM}$ = ±15 V | 80 | | | dB |
| Large Signal Voltage Gain | $A_{VO}$ | $R_L$ = 2 kΩ, −13.5 V ≤ $V_O$ ≤ +13.5 V | 104 | 120 | | dB |
| | | -40ºC ≤ $T_A$ ≤ +125°C | 97 | | | dB |
| Input Resistance, Differential Mode | $R_{INDM}$ | | | TBD | | Ω |
| Input Resistance, Common Mode | $R_{INCM}$ | | | TBD | | Ω |
| Input Capacitance, Differential Mode | $C_{INDM}$ | | | TBD | | pF |
| Input Capacitance, Common Mode | $C_{INCM}$ | | | TBD | | pF |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $R_L$ = 10 kΩ to GND | 14.8 | TBD | | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | V |
| | | $R_L$ = 2 kΩ to GND | 14.7 | TBD | | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | V |
| Output Voltage Low | $V_{OL}$ | $R_L$ = 10 kΩ to GND | | TBD | -14.8 | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | V |
| | | $R_L$ = 2 kΩ to GND | | TBD | -14.7 | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | V |
| Output Current | $I_{SC}$ | | | ±10 | | mA |
| Output Closed-Loop Impedance | $Z_{OUT}$ | | | TBD | | Ω |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection | PSRR | $V_S$ = ±2V to ±18 V | 90 | TBD | | dB |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | dB |
| Quiescent Current | $I_{SY}$ | $I_O$ = 0mA | | 650 | 750 | µA |
| | | −40°C ≤ $T_A$ ≤ +125°C | | | 1000 | µA |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_L$ = 2 kΩ | 2.4 | 4 | | V/µs |
| Unity Gain Bandwidth | UGB | TBD | | 8.3 | | MHz |
| Gain Bandwidth Product | GBWP | TBD | | TBD | | MHz |
| -3dB Bandwidth | -3dB | TBD | | TBD | | MHz |
| Full Power Bandwidth | $BW_P$ | 1% distortion, $R_L$ = 2 kΩ, $V_O$ = 29 V p-p | | TBD | | kHz |
| Settling Time | $t_S$ | To 0.01%, 10 V step | | TBD | | µs |
| Total Harmonic Distortion + Noise | THD+N | | | TBD | | % |
| Phase Margin | $Ø_M$ | | | 60 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Input Voltage Noise | $e_{n p\text{-}p}$ | 0.1 Hz to 10 Hz | | 0.1 | | µV p-p |
| Input Voltage Noise Density | $e_n$ | f = 1 kHz | | 3.9 | | nV/√Hz |
| Input Current Noise Density | $i_n$ | f = 1 kHz | | TBD | | pA/√Hz |

## ELECTRICAL CHARACTERISTICS – VS = ±5V

$V_S$ = ±5 V @ $T_A$ = 25°C, $V_{CM}$ = 0 V, $V_{OUT}$ = 0 V, unless otherwise noted.

**Table 3.**

| Parameter | Symbol | Test Conditions / Comments | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Voltage Offset | $V_{OS}$ | | | | 100 | µV |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | 300 | µV |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | −40 ºC ≤ $T_A$ ≤ +125°C | | 0.2 | | µV/°C |
| Input Bias Current | $I_B$ | | | 80 | 450 | nA |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | 575 | nA |
| Bias Current Drift | $\Delta I_B/\Delta T$ | | | 150 | | pA/°C |
| Input Offset Current | $I_{OS}$ | | | | 50 | nA |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | nA |
| Input Voltage Range | | | -5 | | +5 | V |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = ±4 V, −40 ºC ≤ $T_A$ ≤ +125°C | 86 | 90 | | dB |
| | | $V_{CM}$ = ±5 V | 80 | | | dB |
| Large Signal Voltage Gain | $A_{VO}$ | $R_L$ = 2 kΩ, −4 V ≤ $V_O$ ≤ +4 V | 104 | 120 | | dB |
| | | -40ºC ≤ $T_A$ ≤ +125°C | 97 | | | dB |
| Input Resistance, Differential Mode | $R_{INDM}$ | | | TBD | | Ω |
| Input Resistance, Common Mode | $R_{INCM}$ | | | TBD | | Ω |
| Input Capacitance, Differential Mode | $C_{INDM}$ | | | TBD | | pF |
| Input Capacitance, Common Mode | $C_{INCM}$ | | | TBD | | pF |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $R_L$ = 10 kΩ to GND | 4.8 | TBD | | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | V |
| | | $R_L$ = 2 kΩ to GND | 4.7 | TBD | | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | V |
| Output Voltage Low | $V_{OL}$ | $R_L$ = 10 kΩ to GND | | TBD | -4.8 | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | V |
| | | $R_L$ = 2 kΩ to GND | | TBD | -4.7 | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | V |
| Output Current | $I_{SC}$ | | | ±10 | | mA |
| Output Closed-Loop Impedance | $Z_{OUT}$ | | | TBD | | Ω |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection | PSRR | $V_S$ = ±2 to ±18 V | 90 | TBD | | dB |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | dB⊠ |
| Quiescent Current | $I_{SY}$ | $I_O$ = 0mA | | 650 | 750 | ⊠A |
| | | −40°C ≤ $T_A$ ≤ +125°C | | | 1000 | ⊠A |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_L$ = 2 kΩ | 2.4 | 4 | | V/⊠s |
| Unity Gain Bandwidth | UGB | TBD | | 8.3 | | MHz |
| Gain Bandwidth Product | GBWP | TBD | | TBD | | MHz |
| -3dB Bandwidth | -3dB | TBD | | TBD | | MHz |
| Full Power Bandwidth | $BW_P$ | 1% distortion, $R_L$ = 2 kΩ, $V_O$ = 9 $V_{p-p}$ | | TBD | | kHz |
| Settling Time | $t_S$ | To 0.01% | | TBD | | ⊠s |
| Total Harmonic Distortion + Noise | THD+N | | | TBD | | % |
| Phase Margin | $Ø_M$ | | | 60 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Input Voltage Noise | $e_{np-p}$ | 0.1 Hz to 10 Hz | | 0.1 | | µV p-p |
| Input Voltage Noise Density | $e_n$ | f = 1 kHz | | 3.9 | | nV/√Hz |
| Input Current Noise Density | $i_n$ | f = 1 kHz | | TBD | | pA/√Hz |

## ELECTRICAL CHARACTERISTICS – VS = +3V

$V_S$ = +3 V @ $T_A$ = 25°C, $V_{CM}$ = +1.5 V, unless otherwise noted.

Table 4.

| Parameter | Symbol | Test Conditions / Comments | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Voltage Offset | $V_{OS}$ | | | | 100 | µV |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | 300 | µV |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | −40 ºC ≤ $T_A$ ≤ +125°C | | 0.2 | | µV/°C |
| Input Bias Current | $I_B$ | | | 80 | 450 | nA |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | 575 | nA |
| Bias Current Drift | $\Delta I_B/\Delta T$ | | | 150 | | pA/°C |
| Input Offset Current | $I_{OS}$ | | | | 50 | nA |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | nA |
| Input Voltage Range | | | 0 | | 3 | V |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = 0 V to 3V | 86 | 90 | | dB |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | 80 | | | dB |
| Large Signal Voltage Gain | $A_{VO}$ | $R_L$= 2 kΩ, 0.5 ≤ $V_O$ ≤ +2.5 V | 104 | 120 | | dB |
| | | -40ºC ≤ $T_A$ ≤ +125°C | 97 | | | dB |
| Input Resistance, Differential Mode | $R_{INDM}$ | | | TBD | | Ω |
| Input Resistance, Common Mode | $R_{INCM}$ | | | TBD | | Ω |
| Input Capacitance, Differential Mode | $C_{INDM}$ | | | TBD | | pF |
| Input Capacitance, Common Mode | $C_{INCM}$ | | | TBD | | pF |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $R_L$ = 10 kΩ to $V_{CM}$ | 2.8 | TBD | | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | V |
| | | $R_L$ = 2 kΩ to $V_{CM}$ | 2.7 | TBD | | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | V |
| Output Voltage Low | $V_{OL}$ | $R_L$ = 10 kΩ to $V_{CM}$ | | TBD | 0.2 | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | V |
| | | $R_L$ = 2 kΩ to $V_{CM}$ | | TBD | 0.3 | V |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | | | TBD | V |
| Output Current | $I_{SC}$ | | | ±10 | | mA |
| Output Closed-Loop Impedance | $Z_{OUT}$ | | | TBD | | Ω |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection | PSRR | $V_S$ = ±1.25 to ±1.75 V | 90 | TBD | | dB |
| | | −40 ºC ≤ $T_A$ ≤ +125°C | TBD | | | dB |
| Quiescent Current | $I_{SY}$ | $I_O$ = 0mA | | 650 | 750 | µA |
| | | −40°C ≤ $T_A$ ≤ +125°C | | | 1000 | µA |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_L$ = 2 kΩ | 2.4 | 4 | | V/µs |
| Unity Gain Bandwidth | UGB | TBD | | 8.3 | | MHz |
| Gain Bandwidth Product | GBWP | TBD | | TBD | | MHz |
| -3dB Bandwidth | -3dB | TBD | | TBD | | MHz |
| Full Power Bandwidth | $BW_P$ | 1% distortion, $R_L$ = 2 kΩ, $V_O$ = TBD | | 35 | | kHz |
| Settling Time | $t_S$ | To 0.01% | | TBD | | µs |
| Total Harmonic Distortion + Noise | THD+N | | | TBD | | % |
| Phase Margin | $Ø_M$ | | | 60 | | Degrees |
| NOISE PERFORMANCE | | | | | | |
| Input Voltage Noise | $e_{np-p}$ | 0.1 Hz to 10 Hz | | 0.1 | | µV p-p |
| Input Voltage Noise Density | $e_n$ | f = 1 kHz | | 3.9 | | nV/√Hz |
| Input Current Noise Density | $i_n$ | f = 1 kHz | | TBD | | pA/√Hz |

# ABSOLUTE MAXIMUM RATINGS

Table 5.

| Parameter | Rating |
|---|---|
| Supply Voltage | 36 V |
| Input Voltage | ±V supply |
| Differential Input Voltage | $V^- \le (+IN - -IN) \le V^+$ |
| Output Short-Circuit Duration to Gnd | Indefinite |
| Storage Temperature Range | −65°C to +150°C |
| Operating Temperature Range | −40°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

$\theta_{JA}$ 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 | $\theta_{JA}$ | $\theta_{JC}$ | Unit |
|---|---|---|---|
| 8-Lead SOIC (R-8) | TBD | TBD | °C/W |
| 8-Lead MSOP (RM-8) | TBD | TBD | °C/W |
| 8-Lead LFCSP (CP-8) | TBD | TBD | °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.


PR08237-0-8/11(PrA)