# 36V Precision, 2.5 nV/√Hz, Rail-to-Rail Output Amplifier

## Preliminary Technical Data — AD8675

### FEATURES

**Very Low Voltage Noise 2.5nV/√Hz**
**Rail-to-Rail Output Swing**
**Low Input Bias Current: 5 nA Max**
**Very Low Offset Voltage: 50 µV Max**
**Low Input Offset Drift: 0.6 µV/°C Max**
**Very High Gain: 120 dB**
**Wide Bandwidth: 10MHz**
**±5V to ±15V Operation**

### APPLICATIONS

**Precision Instrumentation**
**PLL Filters**
**Laser Diode Control Loops**
**Strain Gage Amplifiers**
**Medical Instrumentation**
**Thermocouple Amplifiers**

### GENERAL DESCRIPTION

This new precision amplifier has ultra-low offset, drift and voltage noise combined with very low input bias currents over the full operating temperature range. The AD8675 is a precision, wide bandwidth amplifier featuring rail-to-rail output swings and very low noise. Operation is fully specified from ±5V to ±15 volts.

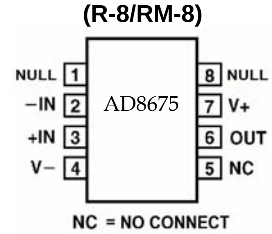
The AD8675 combines the R-R output of the OP184 with wide bandwidth and even lower voltage noise and with the precision and low power consumption of the industry-standard OP07 amplifier. Unlike other low noise R-R amplifiers the AD8675 has very low input bias current and low input current noise.

With an offset voltage of only 20µV, offset drift of 0.2 µV/°C and noise of only 0.25uV P-P (0.1Hz to 10 Hz) the AD8675 is perfectly suited for applications where large error sources cannot be tolerated. For applications with even lower offset tolerances, the proprietary nulling capability allows a combination of both device and system offset errors up to 1mV(referred to the input) to be compensated externally. Unlike previous circuits, the AD8675 accommodates this adjustment without adversely affecting the offset drift, CMRR and PSRR of the amplifier. Precision Instrumentation, PLL and other precision filter circuits, position and pressure sensors, medical instrumentation, and strain gage amplifiers benefit greatly from the very low noise, low input bias current and wide bandwidth. Many systems may take advantage of the low noise, DC precision and rail-to-rail output swing provided by the AD8675 to maximize SNR and dynamic range.

The smaller packages and low power consumption afforded by the AD8675 allow maximum channel density or minimum board size for space-critical equipment.

The AD8675 is specified for the extended industrial (-40° to +125°C) temperature range. The AD8675 amplifier is available in the tiny MSOP-8 and the popular 8-pin narrow SOIC lead-free packages. MSOP packaged devices are only available in Tape-and-Reel format.

**8-Lead SOIC/8-Lead MSOP**
**(R-8/RM-8)**






One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 617/329-4700 World Wide Web Site: http://www.analog.com
Fax: 617/326-8703

# ELECTRICAL SPECIFICATIONS ($V_S$=±5.0V, $V_{CM}$ = 0V, $V_O$=0V, $T_A$=+25°C unless otherwise specified.)

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Offset Voltage | $V_{OS}$ | | | 20 | 50 | μV |
| Input Bias Current | $I_B$ | | | 2 | 5 | nA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | 3 | 6 | nA |
| Input Offset Current | $I_{OS}$ | | | 0.5 | 1 | nA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | | 2 | nA |
| Input Voltage Range | | | -3.5 | | 3.5 | V |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = -3.5V to 3.5V | 110 | 120 | | dB |
| | | -40°C ≤ $T_A$ ≤ +125°C | 105 | 115 | | dB |
| Open Loop Gain (Note 1) | $A_{VO}$ | $R_L$ = 2 kΩ to Ground, Vo=-4.0V to 4.0V | 120 | | | dB |
| | | -40°C ≤ $T_A$ ≤ +125°C | 120 | | | dB |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | -40°C ≤ $T_A$ ≤ +125°C | | 0.2 | 0.6 | μV/°C |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $R_L$ = 2kΩ to Ground | 4.9 | 4.92 | | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | 4.8 | 4.85 | | V |
| | | $R_L$ = 600Ω to Ground | 4.5 | 4.55 | | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | 4.4 | 4.45 | | V |
| Output Voltage Low | $V_{OL}$ | $R_L$ = 2kΩ to Ground | | -4.92 | -4.9 | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | | -4.85 | -4.8 | V |
| | | $R_L$ = 600Ω to Ground | | -4.55 | -4.5 | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | | -4.45 | 4.4 | V |
| Short Circuit Limit | $I_{SC}$ | | | 40 | | mA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | 30 | | mA |
| Output Current | $I_O$ | | | ± 20 | | mA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | ± 15 | | mA |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection Ratio | PSRR | $V_S$ = =±5.0V to ±15.0V | 100 | 110 | | dB |
| | | -40°C ≤ $T_A$ ≤ +125°C | 100 | 110 | | dB |
| Supply Current/Amplifier | $I_{SY}$ | $V_O$ = 0V | | 2.5 | 3 | mA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | | 3.2 | mA |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_L$ =2 kΩ | | 1 | | V/μs |
| Gain Bandwidth Product | GBP | | | 10 | | MHz |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{n\ p\text{-}p}$ | 0.1 to 10 Hz | | 0.1 | | $\mu V_{p\text{-}p}$ |
| Voltage Noise Density | $e_n$ | f = 1 kHz | | 2.5 | | nV/√Hz |
| Current Noise Density | $i_n$ | f =10 Hz | | 0.3 | | pA/√Hz |

# ELECTRICAL SPECIFICATIONS ($V_S$ = ±15V, $V_{CM}$ = 0V, $V_O$ = 0V, $T_A$=+25°C unless otherwise specified.)

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| INPUT CHARACTERISTICS | | | | | | |
| Offset Voltage | $V_{OS}$ | | | 20 | 50 | μV |
| Input Bias Current | $I_B$ | | | 2.5 | 5 | nA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | 3 | 6 | nA |
| Input Offset Current | $I_{OS}$ | | | 50 | 1 | nA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | | 2 | nA |
| Input Voltage Range | | | -13.5 | | 13.5 | V |
| Common-Mode Rejection Ratio | CMRR | $V_{CM}$ = -12.5V to 12.5V | 110 | 120 | | dB |
| | | -40°C ≤ $T_A$ ≤ +125°C | 105 | 110 | | dB |
| Open Loop Gain | $A_{VO}$ | $R_L$ = 2kΩ to Ground, Vo=-14.0V to 14.0V | 120 | | | dB |
| | | -40°C ≤ $T_A$ ≤ +125°C | 120 | | | dB |
| Offset Voltage Drift | $\Delta V_{OS}/\Delta T$ | -40°C ≤ $T_A$ ≤ +125°C | | 0.2 | 0.6 | μV/°C |
| OUTPUT CHARACTERISTICS | | | | | | |
| Output Voltage High | $V_{OH}$ | $R_L$ = 2kΩ to Ground | 14.9 | 14.95 | | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | 14.8 | 14.85 | | V |
| | | $R_L$ = 600Ω to Ground | 14.5 | 14.55 | | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | 14.4 | 14.45 | | V |
| Output Voltage Low | $V_{OL}$ | $R_L$ = 2kΩ to Ground | | -14.95 | -14.9 | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | | -14.85 | -14.8 | V |
| | | $R_L$ = 600Ω to Ground | | -14.55 | -14.5 | V |
| | | -40°C ≤ $T_A$ ≤ +125°C | | -14.45 | -14.4 | V |
| Short Circuit Limit | $I_{SC}$ | | | 40 | | mA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | 30 | | mA |
| Output Current | $I_O$ | | | ± 20 | | mA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | ± 15 | | mA |
| POWER SUPPLY | | | | | | |
| Power Supply Rejection Ratio | PSRR | $V_S$ = =±5.0V to ±15.0V | 100 | 110 | | dB |
| | | -40°C ≤ $T_A$ ≤ +125°C | 100 | 110 | | dB |
| Supply Current/Amplifier | $I_{SY}$ | $V_O$ = 0V | | 2.5 | 3 | mA |
| | | -40°C ≤ $T_A$ ≤ +125°C | | | 3.2 | mA |
| DYNAMIC PERFORMANCE | | | | | | |
| Slew Rate | SR | $R_L$ =10 kΩ | | 1 | | V/μs |
| Gain Bandwidth Product | GBP | | | 10 | | MHz |
| NOISE PERFORMANCE | | | | | | |
| Voltage Noise | $e_{n\ p\text{-}p}$ | 0.1 to 10 Hz | | 0.1 | | $\mu V_{p\text{-}p}$ |
| Voltage Noise Density | $e_n$ | f = 1 kHz | | 2.5 | | nV/√Hz |
| Current Noise Density | $i_n$ | f = 10 Hz | | 0.3 | | pA/√Hz |

### ABSOLUTE MAXIMUM RATINGS

Supply Voltage ........................................................ ±18V
Input Voltage ........................................................ ±Vsupply
Differential Input Voltage ........................................ ±0.7V
Output Short-Circuit Duration to Gnd ........................ Indefinite
Storage Temperature Range
  RM, R Package ................................. -65°C to +150°C
Operating Temperature Range
  AD8675 ........................................... -40°C to +125°C
Junction Temperature Range
  RM, R Package ................................. -65°C to +150°C
Lead Temperature Range (Soldering, 10 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 listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

| Package Type | $\theta_{JA}$[1] | $\theta_{JC}$ | Units |
|---|---|---|---|
| 8-Pin MSOP (RM) | 210 | 45 | °C/W |
| 8-Pin SOIC (R) | 158 | 43 | °C/W |

NOTES
[1] $\theta_{JA}$ is specified for the worst case conditions, i.e., $\theta_{JA}$ is specified for device in socket for P-DIP packages; $\theta_{JA}$is specified for device soldered in circuit board for SOIC and TSSOP packages.

**ORDERING GUIDE**

| Model | Temperature Range | Package Description | Package Option |
|---|---|---|---|
| AD8675ARMZ | -40°C to +125°C | 8-Pin MSOP | RM-8 |
| AD8675ARZ | -40°C to +125°C | 8-Pin SOIC | R-8 |

PR05564-0-5/05(PrA)