# Single Supply Sensor Interface Amplifier

# AD22057*

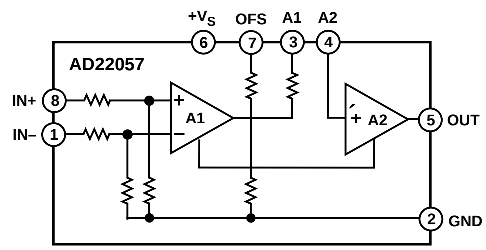
## FEATURES

**Gain of ×20 Alterable from ×1 to ×160**
**Input Offset Voltage Over Temperature ±2 mV**
**Low Long-Term Drift of Gain and Offset Voltage**
**Input CMR from Ground to 6× ($V_S$–1 V)**
**Output Span 20 mV to ($V_S$–0.25) V**
**1, 2, 3 Pole Low-Pass Filtering Available**
**Accurate Midscale Offset Capability**
**Differential Input Resistance 400 kΩ**
**Drives 1 kΩ Load to +4 V Using $V_S$ = +5 V**
**Supply Voltage: +3 V to +36 V**
**Transient Spike Protection and RFI Filters Included**
**Peak Input Voltage (40 ms): 60 V**
**Reversed Supply Protection: –34 V**
**Operating Temperature Range: –40°C to +125°C**

## APPLICATIONS

**Current Sensing**
**Motor Control**
**Interface for Accelerometers, Pressure Transducers, Position Indicators, Strain Gages, and Other Low Level Signal Sources**

## FUNCTIONAL BLOCK DIAGRAM




## GENERAL DESCRIPTION

The AD22057 is a single supply difference amplifier for the amplification and low-pass filtering of small differential voltages from sources having a large common-mode voltage.

Supply voltages of between +3 V and +36 V can be used. The input common-mode range extends from below ground to 24 V using a +5 V supply with excellent rejection of this common-mode voltage.

This range is achieved by the use of a special resistive attenuator at the input, laser-trimmed to a very high differential balance. Low initial offset voltage and offset voltage drift are specified, and long-term stability of gain and offset voltage is also provided.

Provisions are included for optional low-pass filtering and gain adjustment. An accurate midscale offset feature allows bipolar signals to be amplified.

*Patents pending.

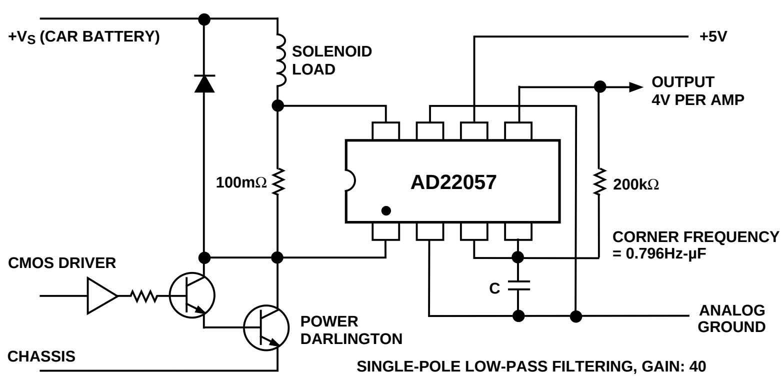



*Figure 1. Typical Application Circuit for a Current Sensor Interface*

REV. 0



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# AD22057–SPECIFICATIONS (@ $T_A$ = + 25°C, $V_S$ = +5 V, $V_{CM}$ = 0, unless otherwise noted)

| Parameter | Comments | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| INPUTS (PINS 1 AND 8) | | | | | | |
| +CMR | Positive Common-Mode Range | | | | +24 | V |
| CMR | Negative Common-Mode Range | $T_A = T_{MIN}$ to +85°C | –1.0 | | | V |
| $CMRR_{LF}$ | Common-Mode Rejection Ratio | f ≤ 10 Hz | 80 | 90 | | dB |
| $CMRR_{HF}$ | Common-Mode Rejection Ratio | f = 1 kHz | 80 | 90 | | dB |
| $R_{INCM}$ | Common-Mode Input Resistance | Pin 1 or Pin 8 to Pin 2 | 200 | 250 | 300 | kΩ |
| $R_{MATCH}$ | Matching of Input Resistances | | | ±05 | | % |
| $R_{INDIFF}$ | Differential Input Resistance | Pin 1 to Pin 8 | 350 | 450 | | kΩ |
| PREAMPLIFIER | | | | | | |
| $G_{CL}$ | Closed-Loop Gain[1] | | 9.7 | 10.0 | 103 | V/V |
| $V_O$ | Output Voltage Range (Pin 3) | | +0.01 | | +4.8 | V |
| $R_O$ | Output Resistance[2] | | 97 | 100 | 103 | kΩ |
| OUTPUT BUFFER | | | | | | |
| $G_{CL}$ | Closed-Loop Gain[1] | $R_{LOAD}$ ≥ 10 kΩ | 1.94 | 2.0 | 2.06 | V/V |
| $V_O$ | Output Voltage Range | | +0.02 | | +4.8 | V |
| $R_O$ | Output Resistance (Pin 5) | $V_O$ ≥ 0.1 V dc | | 0.2 | | Ω |
| OVERALL SYSTEM | | | | | | |
| $G_{CL}$ | Gain[1] | $V_O$ ≥ 0.1 V dc | 19.9 | 20.0 | 20.1 | V/V |
| | Gain Drift | $T_A = T_{MIN}$ to $T_{MAX}$ | –62.5 | | +62.5 | ppm/°C |
| $V_{OS}$ | Initial Offset Voltage[3] | | –1 | 0.03 | 1 | mV |
| | Offset Drift | $T_A = T_{MIN}$ to $T_{MAX}$ | –12.5 | | +12.5 | μV/°C |
| OFS | Midscale Offset (Pin 7) Scaling[4] | | 0.49 | 0.50 | 0.51 | V/V |
| | Input Resistance | Pin 7 to Pin 2 | 2.5 | 3.0 | | kΩ |
| IOSC | Short-Circuit Output Current | | 7 | 11 | 25 | mA |
| $BW_{-3\ dB}$ | –3 dB Bandwidth | $V_O$ = + 1 V dc | 20 | 30 | | kHz |
| SR | Slew Rate | | | 0.2 | | V/μs |
| $N_{SD}$ | Noise Spectral Density[3] | f = 100 Hz to 10 kHz | | 0.2 | | $\mu V/\sqrt{Hz}$ |
| POWER SUPPLY | | | | | | |
| $V_S$ | Operating Range | $T_A = T_{MIN}$ to $T_{MAX}$ | 3 | 5 | 36 | V |
| $I_S$ | Quiescent Supply Current[5] | $T_A$ = +25°C, $V_S$ = +5 V | | 200 | 500 | μA |
| TEMPERATURE RANGE | | | | | | |
| $T_{OP}$ | Operating Temperature Range | | –40 | | +105 | °C |
| PACKAGE | Plastic Mini-DIP (N-8) | | | AD22057N | | |
| | SOIC (R-8) | | | AD22057R | | |

NOTES

[1]Specified for default mode i.e., with no external components. The overall gain is trimmed to ±1% while the individual gains of Al and A2 may be subject to a maximum ±3% tolerance. Note that the actual gain in a particular application can be modified by the use of external resistor networks.

[2]The actual output resistance of A1 is only a few ohms, but access to this output, via Pin 3, is always through a 100 kΩ resistor, which is trimmed to ±3%.

[3]Referred to the input (Pins 1 and 8).

[4]The midscale offset scaling factor determines the fraction of voltage applied to Pin 7 which appears at the output. For example, with Pin 7 tied to Pin 6 and $V_S$ = +5 V, the output will be offset to +2.5 V ± 50 mV. The designer should be aware that the impedance at Pin 7, OFS, is 4 kΩ. Care should be taken so that the steady-state voltage at this pin does not cause the package to dissipate too much power. It is recommended that the continuous $V_S$ stay below +20 V when it is connected to the OFS pin.

[5]With $V_{DM}$ = 0 V. Differential mode signals are referred to as $V_{DM}$, while $V_{CM}$ refers to common-mode voltages.

All min and max specifications are guaranteed, although only those marked in **boldface** are tested on all production units at final test.

Specifications subject to change without notice.

## ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . . . . . . . . . . . . . . . . . . . . . . +3 V to +36 V
Peak Input Voltage (40 ms) . . . . . . . . . . . . . . . . . . . . . . . . 60 V
Reversed Continuous Supply Voltage . . . . . . . . . . . . . . –34 V
Operating Temperature . . . . . . . . . . . . . . . . –40°C to +125°C
Storage Temperature . . . . . . . . . . . . . . . . . . –65°C to +150°C
Output Short Circuit Duration . . . . . . . . . . . . . . . . Indefinite
Lead Temperature (Soldering, 60 sec) . . . . . . . . . . . . . +300°C

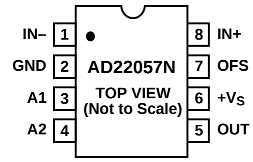
[1]Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only; the functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ORDERING GUIDE

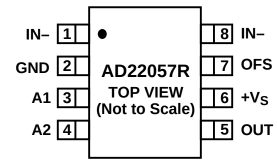
| Model | Temperature Range | Package Description | Package Option |
|---|---|---|---|
| AD22057N | –40°C to +105°C | Plastic Mini-DIP | N-8 |
| AD22057R | –40°C to +105°C | SOIC | R-8 |

## PIN CONFIGURATIONS

**Plastic Mini-DIP (N-8)**




**SOIC (R-8)**



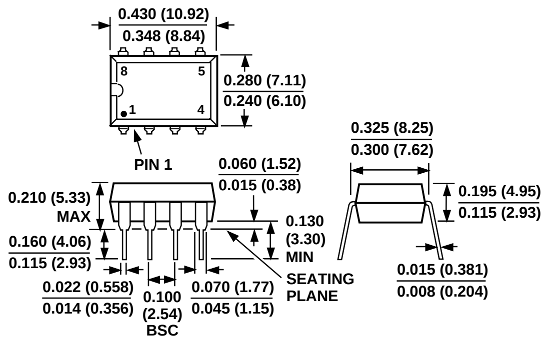

**CAUTION**

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD22057 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

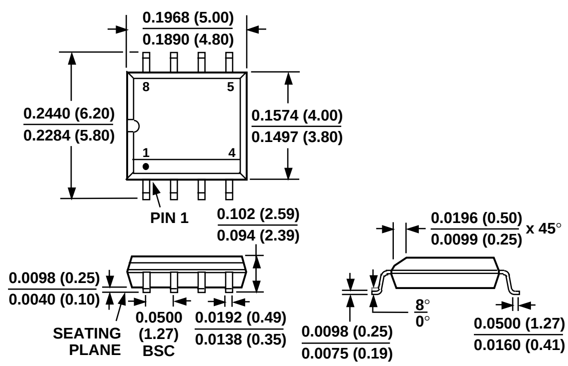
## OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

### Plastic Mini-DIP (N-8)




### SOIC (R-8)

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