High Voltage Current Shunt Monitor

Preliminary Technical Data

AD8212

FEATURES

- High common-mode voltage range
  - 7 V to +65 V operating (no outside pass transistor)
  - 7 V to >500 V survival (with outside pass transistor)
- Adjustable gain
- Bidirectional current measurement
- Wide operating temperature range
  - Die: –40°C to +150°C
  - 8-lead SOIC: –40°C to +125°C
- Available in SOIC and die form

APPLICATIONS

- High-side current sensing
- Motor controls
- Battery monitoring
- Hybrid vehicle control
- Diesel injection controls
- Vehicle dynamic controls
- Dc-to-dc converters

FUNCTIONAL BLOCK DIAGRAM

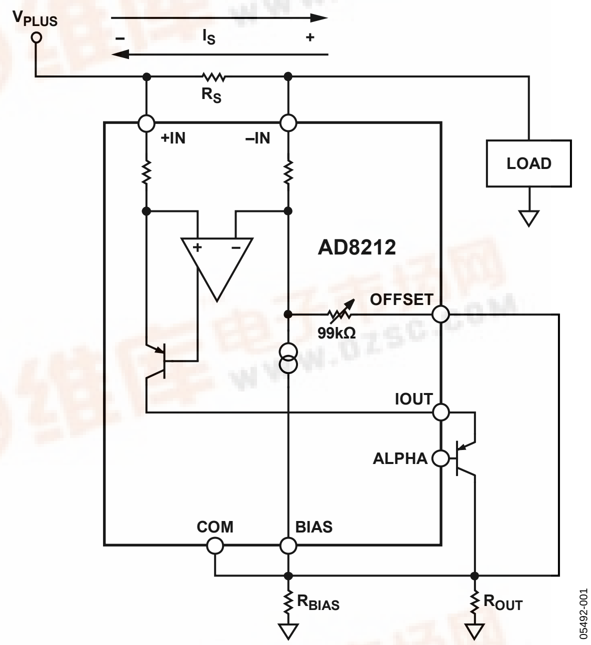

Figure 1.

GENERAL DESCRIPTION

The AD8212 is a self-biased current sense amplifier for level shifting and amplifying small differential voltages in the presence of common mode voltages exceeding 500 V[1]. The AD8212 offers excellent accuracy and programmable gain which can be set with a single resistor, making it ideal to use in industrial, automotive , and consumer applications.

The AD8212 is offered in die and packaged form. The operating temperature range for the die is 25°C higher (up to 150°C) than that of the packaged part to enable the user to apply the AD8212 in high temperature applications.

Excellent AC and DC performance over temperature keep errors in the measurement loop to a minimum. Offset drift is typically below 5 uV/ °C, and the gain drift is typically below 50 ppm/°C.

[1] Depending upon Vce breakdown voltage of pass transistor

Rev. PrA

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

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SPECIFICATIONS

T_A = Operating temperature range.

Table 1.

Parameter	AD8212 SOIC[1] Min	AD8212 SOIC[1] Typ	AD8212 SOIC[1] Max	AD8212 DIE[2] Min	AD8212 DIE[2] Typ	AD8212 DIE[2] Max	Unit	Conditions
GAIN								
Initial	1		100	1		100	V/V	
Accuracy		±0.5	±1		±0.5	±1.5	%	25°C, V_O ≥ 0.1 V dc
Accuracy Over Temperature			±1.5			±2.5	%	Specified temperature range
Gain vs. Temperature		50			50		ppm/°C	
VOLTAGE OFFSET								
Offset Voltage (RTI)			±1			±2	mV	25°C
Over Temperature (RTI)			±2			±4	mV	Specified temperature range
Offset Drift		5			5		µV/°C	
INPUT								
Input Impedance								
Differential		2			2		kΩ	
Input Voltage Range	7		65	7		65	V	No outside pass transistor
	7		>500	7		>500	V	With outside pass transistor
Differential Input Range[3]		100			100		mV	Differential
Common-Mode Rejection		90			90		dB	25°C, f = dc to 20 kHz[4]
OUTPUT								
Output Voltage Range	0.05		V_{PLUS} − 5 V	0.05		V_{PLUS} − 5 V	V	R_L = 25 kΩ
DYNAMIC RESPONSE								
Small Signal – 3 dB Bandwidth		500			500		kHz	
Slew Rate		3			3		V/µs	
NOISE								
0.1 Hz to 10 Hz, RTI		TBD			TBD		µV p-p	
Spectral Density, 1 kHz, RTI		TBD			TBD		µV/√Hz	

[1] T_{MIN} to T_{MAX} = −40°C to +125°C.
[2] T_{MIN} to T_{MAX} = −40°C to +150°C.
[3] Input voltage range = ±75 mV with half-scale offset.
[4] Source imbalance <2 Ω.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Continuous Input Voltage	7V to +65 V (No Pass Transistor)
Transient Input Voltage	72 V
Operating Temperature Range	−40°C to +125°C
Storage Temperature Range	−65°C to +150°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.

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

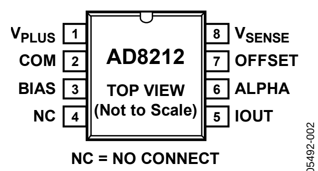

Figure 2. Pin Configuration

THEORY OF OPERATION

The AD8212 is a self-biased, high common mode current sense amplifier.

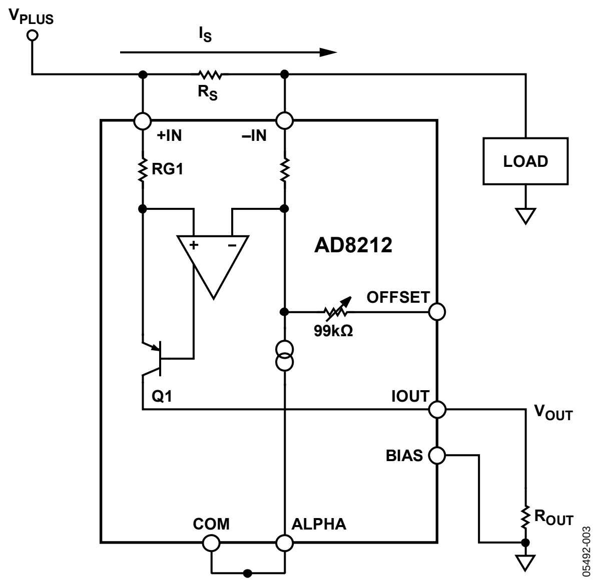

Figure 3. Typical Connection Diagram

The current (I_S) is drawn for the supply through the shunt resistor (R_S). This produces a small voltage (Vshunt) across the inputs of the device, and in turn current flows across RG1 (1000 Ω) into the collector of Q1. This current (IOUT) is converted into a voltage through the use of an outside resistor (R_{OUT}).

RG1 = 1000Ω Vshunt = (Is * Rs)

Iout = (Is * Rs) / (RG1) Vout = (Is * Rs * Rout) / RG1

Table 3 lists the Rout values and the resulting gain for the AD8212.

Table 3.

Rout (Ω)	Gain (V/V)
1k	1
2k	2
5k	5
10k	10
20k	20
50k	50
100k	100

With the device operating in the manner shown above the common mode voltage range is 7V to 65V. The 7V is necessary for the device to operate because of an internal regulator that turns on at that voltage. This internal regulator allows the AD8212 to be self biased, meaning that the AD8212 hangs from the common mode voltage, and no additional supply is necessary. This internal regulator also maintains 5 V at all times between the Vplus and COM. Therefore, the device always sees 5 V across, no matter what the common mode voltage. The AD8212 can operate with voltages of up to 500V with the use of an external pass transistor.

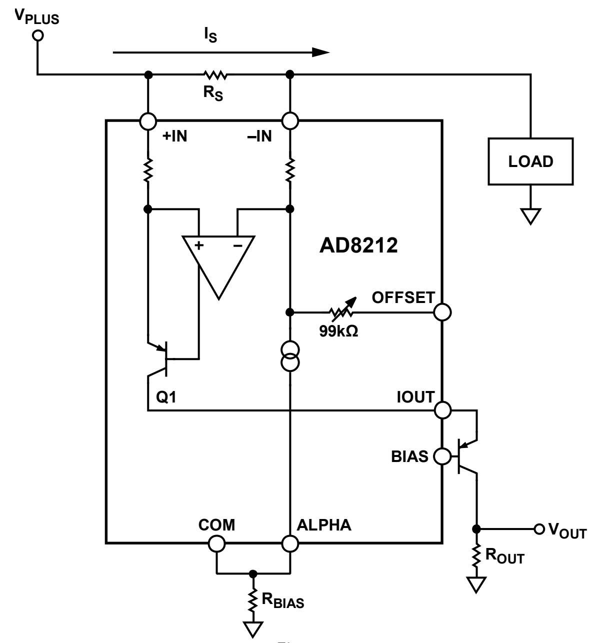

Figure 4.

At these high voltages a proper Rbias (depended upon the application) is necessary to regulate the device by pulling enough current through it to keep it to keep it going.

Ibias = (Vsupply –5V)/ Rbias

The current necessary must be at least 90uA and can be as high as 1mA. The formula above can be used to easily calculate the external Rbias to deliver the proper current.

The Offset pin can be tied to COM for bidirectional current measurements. The Offset voltage can be calculated by:

Voffset = (5 * 10^-5) * Rout

Between Vplus and COM there is 5V. When Offset is tied to Com we have a resistor divider of 1K and 99K and 5V. Therefore the current flowing to the Q1 collector is 0.5V/1kΩ=(5*10^-5). This current multiplied with Rout produces the offset voltage. A high voltage PNP transistor is necessary for using the AD8212 at high voltages. The only limitation on what Common Mode Voltage range, is the breakdown voltage of the pass transistor.

MODES OF OPERATION

The output of the AD8212 can be adjusted for unidirectional or bidirectional operation.

LOW VOLTAGE UNIDIRECTIONAL OPERATION

Unidirectional operation allows the AD8212 to measure currents through a resistive shunt in one direction. The offset pin is not used and the Bias pin is directly connected to GND.

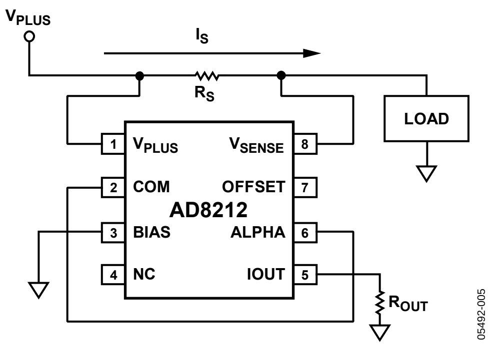

Figure 5. Low Voltage Unidirectional Operation

LOW VOLTAGE BIIDIRECTIONAL OPERATION

By tying pin 7 (Offset) to COM the AD8212 can measure currents in both directions at the input.

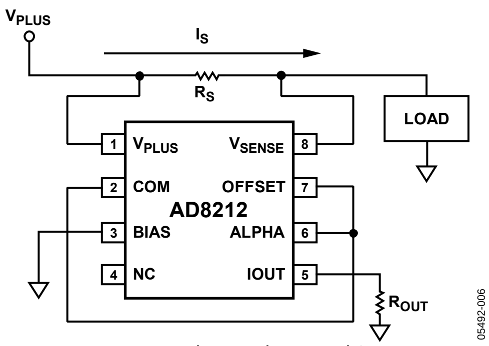

Figure 6. Low Voltage Bidirectional Operation

HIGH VOLTAGE UNIDIRECTIONAL OPERATION

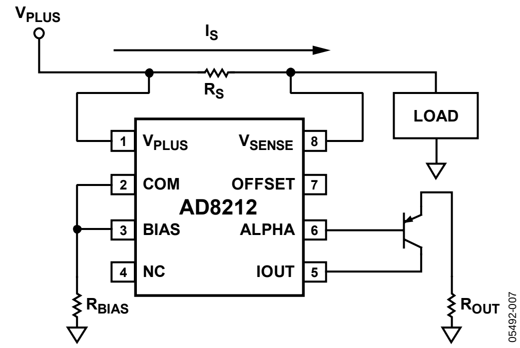

Figure 7. High Voltage Unidirectional Operation

HIGH VOLTAGE BIDIRECTIONAL OPERATION

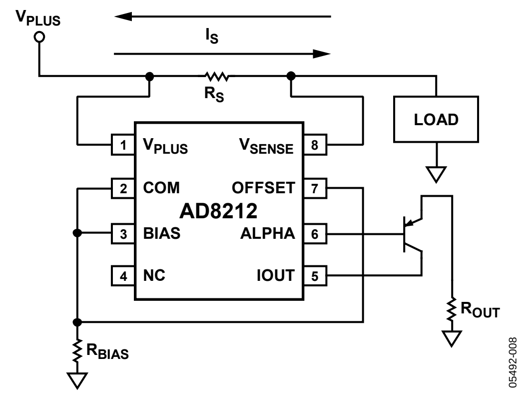

Figure 8.. High Voltage Unidirectional Operation

OUTLINE DIMENSIONS

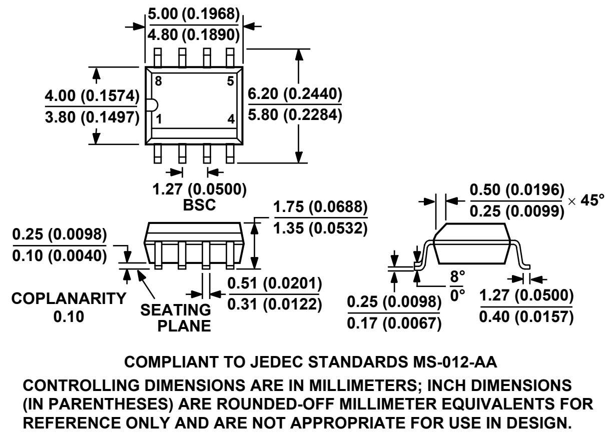

Figure 9. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches

NOTES