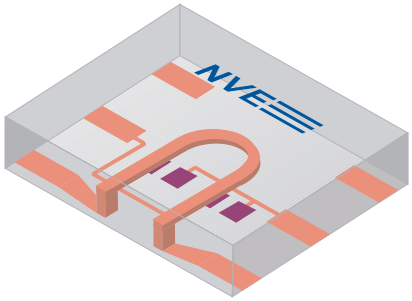
ACT001-10E Isolated Current Sensor

Key Features



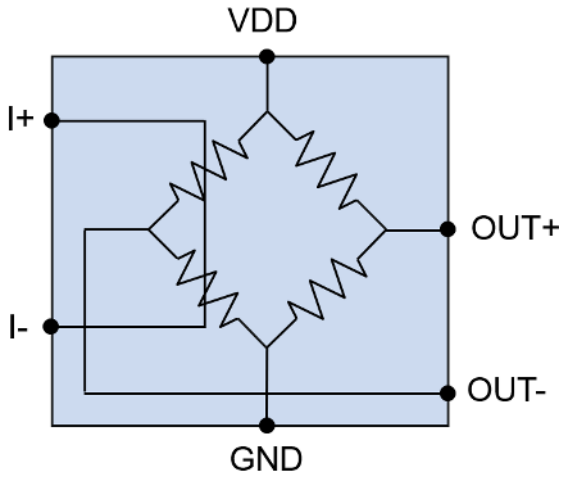
- For low-current detection and measurement
- On-chip current strap for precise operation
- Electrically isolated for removing ground loops
- −500 mA to +500 mA linear range
- 0.04 mV/V-mA sensitivity
- Ratiometric output for power measurement
- AC or DC measurement
- Ultraminiature 2.5 mm x 2.5 mm x 0.8 mm DFN6

Applications

- AC and DC motor control
- Power measurement
- Overcurrent protection
- Battery management systems

Description

The ACT001-10E is a high-linearity, extremely low-hysteresis current sensor manufactured with NVE's state-of-the-art tunneling magnetoresistance (TMR) technology. The sensor has an on-chip current strap close to TMR sensor elements that enable highly sensitive and accurate measurements. The sensor output is a bipolar voltage signal proportional to the current through the strap.



ACT001-10E Block Diagram

Operating Specifications

Parameter	Test Conditions	Min.	Typ.	Max.	Units
Nominal Bridge Resistance	25°C	10		20	kΩ
Sensitivity	Operating; 5 V Supply, 25°C	0.03	0.04	0.05	mV/V-mA
Frequency Response		300			kHz
Linear Range of Current Measurement	Operating; Full Voltage and Temperature Range	−500		500	mA
Saturation Current		±1000		±1500	mA
Output Linearity	Over Linear Current Range; Full Oper. Temperature Range			1	%
Hysteresis				1	%
Bridge Electrical Offset	25°C	−2		+2	mV/V
Bridge Supply Voltage		0		14	|Volts|
Isolation Voltage	See Note 1	240			V_{RMS}
On-Chip Current Strap Resistance	25°C	0.4		0.65	Ω
On-Chip Current Strap Resistance Temperature Coefficient			+0.6		%/°C
Operating Temperature Range	Operating	−40		150	°C
Temperature Coefficient of Sensitivity	TCOV	−0.2		0.2	%/°C
Offset Drift over Temperature	TCO		25		µV/°C
External Magnetic Interference Rejection		2			mT

Notes:

1. For isolation measurement, the sensor is considered a two terminal device: I_+ and I_- pins (pins 3 and 4) are shorted, and bridge pins (pins 1, 2, 5, and 6) are shorted.

Absolute Maximum Ratings

Parameter	Min.	Typ.	Max.	Units
Absolute Maximum Steady-State Current	−500		500	mA
Bridge Supply Voltage	0		14	Volts
Storage Temperature	−40		170	°C
Ambient Magnetic Field	Unlimited			

Note: Exceeding Absolute Maximum Ratings may cause permanent damage.

ACT001-10E Operation

A representative transfer curve is shown below:

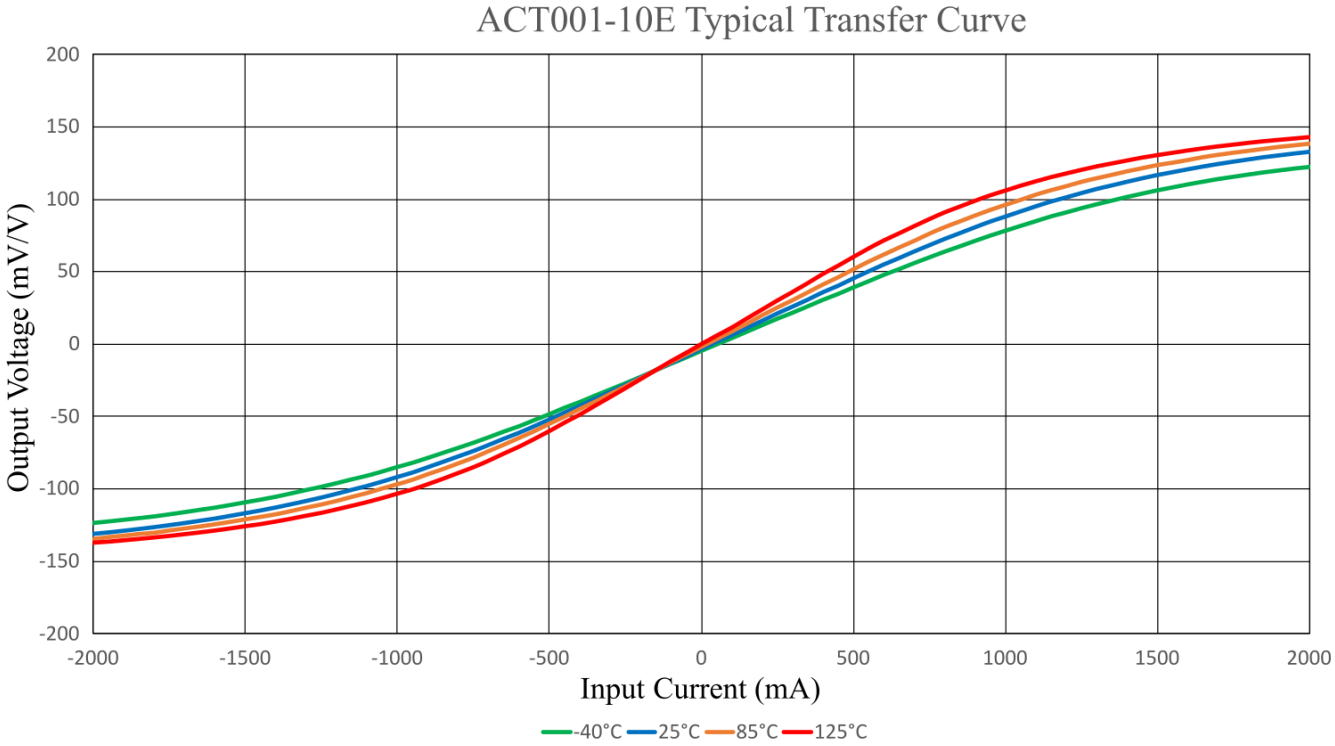


Figure 1: Typical ACT001 operating characteristic over temperature.

Application Circuits

Offset Correction

There are a number of ways to correct the sensor's offset if necessary. One method is a potentiometer:

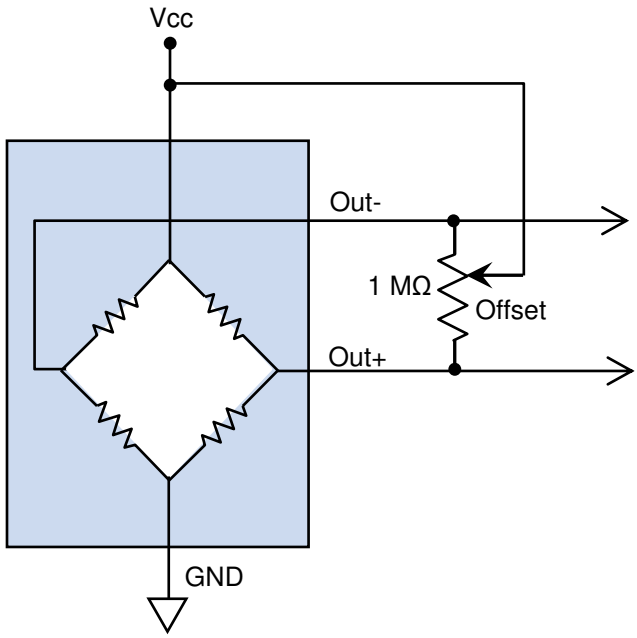


Figure 2. Offset correction with a potentiometer.

Differential Amplifier

An op-amp can be used to provide a single-ended amplified output. The circuit below has a gain of 20 for full-scale at approximately the sensor's maximum output. The potentiometer provides a positive offset so negative currents still produce a positive output, and corrects the sensor's offset. The 500 kΩ input resistors are significantly higher than the sensor output impedance to avoid loading. The capacitor limits high-frequency noise. The low-cost, low bias current op amp allows large resistors to avoid loading the sensor bridge.

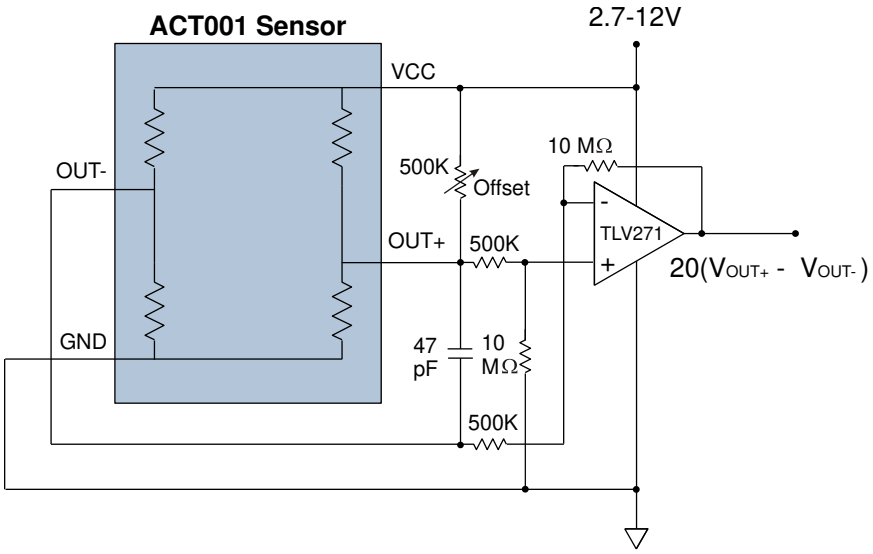


Figure 3. Differential amplifier circuit.

Overcurrent Switch

A comparator can be used to provide overcurrent detection:

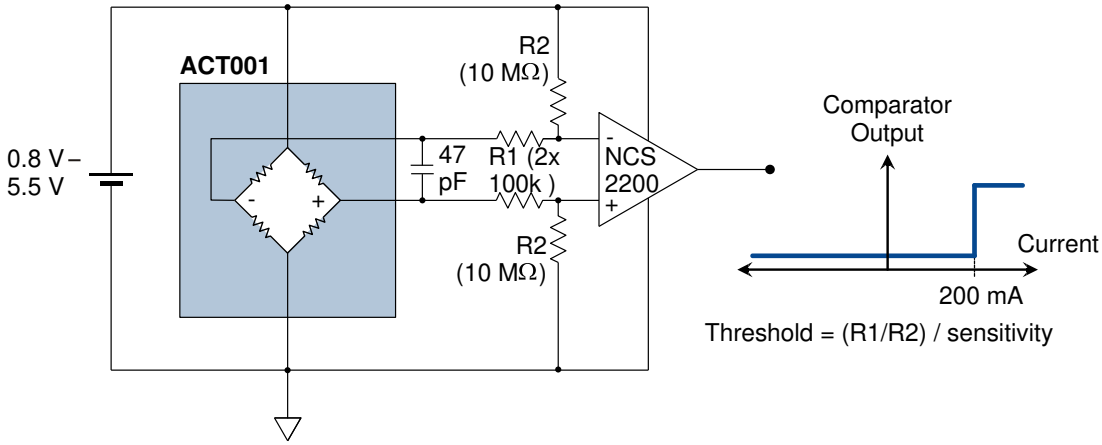


Figure 4. Single-comparator overcurrent circuit.

The resistors set the switching threshold, which is equal to (R1/R2) / Sensitivity. The capacitor limits high-frequency noise.

Overcurrent Switch with Hysteresis

Hysteresis can be added to a single- comparator overcurrent circuit to minimize spurious switching:

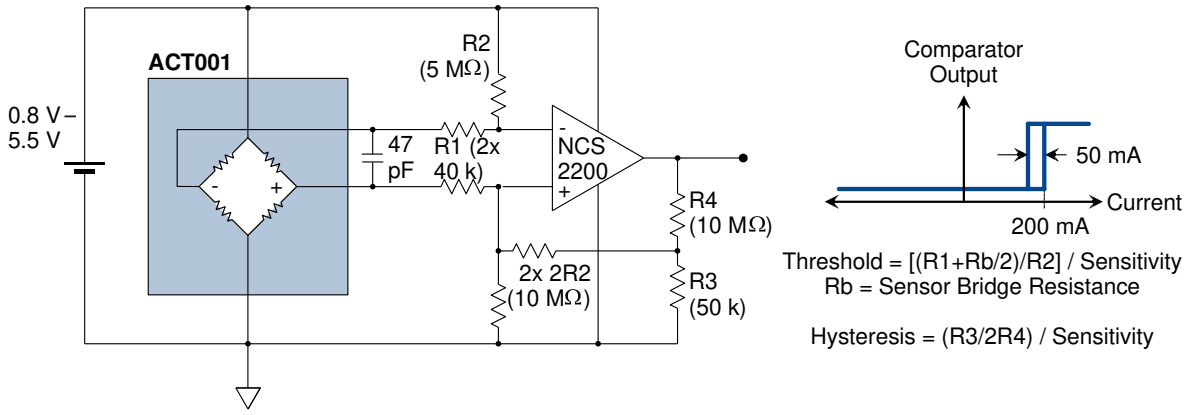


Figure 5. Overcurrent comparator circuit with hysteresis.

Three additional resistors set the hysteresis, which is equal to (R3/2R4) / Sensitivity.

Power Sensor

Since the sensor output is ratiometric with the power supply, the ACT001 can be used as a power sensor with no additional components and no multiplication required:

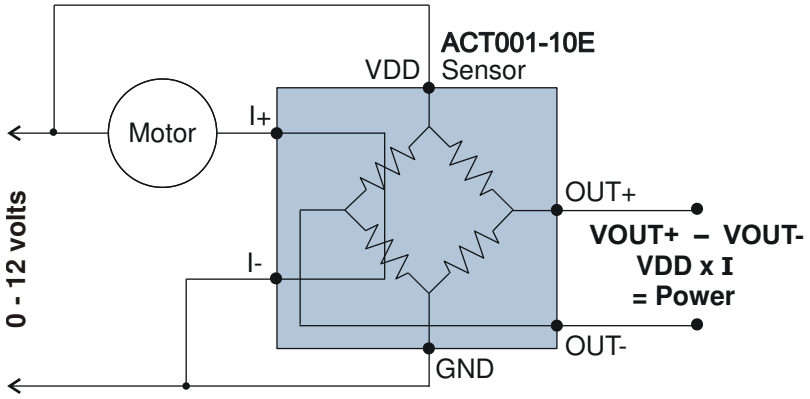


Figure 6. Power sensor.

The sensor output is proportional to both the motor voltage and the motor current, so the sensor output is proportional to power. Since the sensor has no active elements, it is accurate down to zero supply voltage.

Pinout

The ACT001-10E pinout is as follows:

Pin	Terminal	Description
1	V_+	Supply Voltage
2	Out_+	Positive Differential Bridge Output
3	I_+	Current Terminal 1
4	I_-	Current Terminal 2
5	Out_-	Negative Differential Bridge Output
6	V_-	Ground

Notes:

1. Pins are numbered counterclockwise around the package.
2. Current entering the chip via terminal I_+ and leaving the chip via terminal I_- produces a positive bridge output.

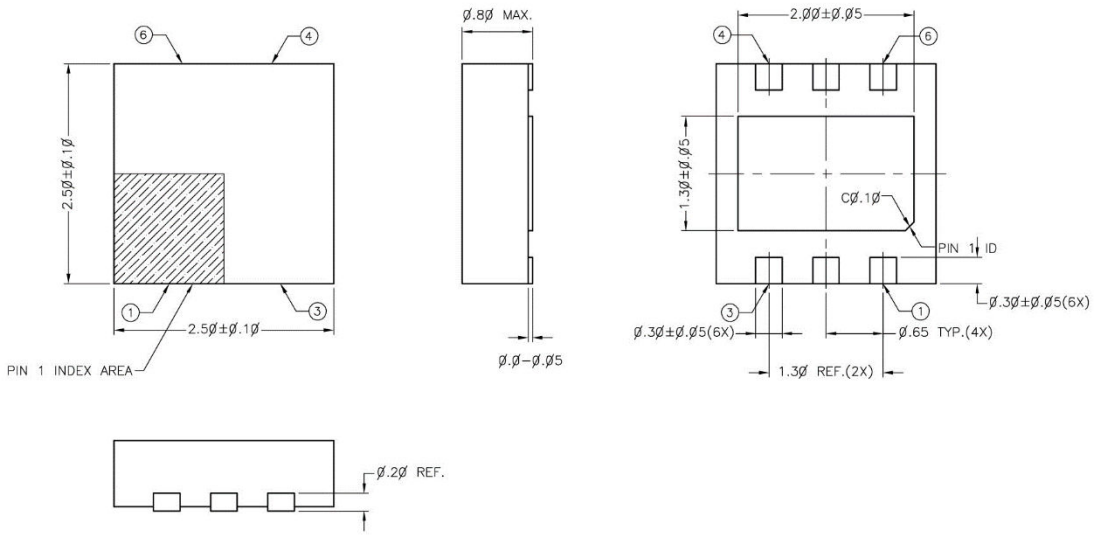
Available Parts

Part Number	Marking	Description
ACT001-10E	CTA	+/- 500 mA isolated current sensor

Package Drawing

Notes:

- Dimensions in mm.



- TDFN6 package has thermal power dissipation of 320°C/Watt in free air.
- Attaching the package to a circuit board improves thermal performance, especially if the center pad is also soldered to the board.
- The center pad may be left floating or connected to ground.

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Revision History

SB-00-149 Rev A February 2022	Original Release