

# TS1105/06/09 Current Sense Amplifier EVB User's Guide

The TS1105, TS1106, and TS1109 combine a high-side current sense amplifier (CSA) with a buffered output featuring an adjustable bias. The TS1109 bidirectional CSA buffered output uses a bipolar scheme with respect to the bias voltage, while the TS1106 bidirectional CSA buffered output uses a unipolar scheme.

The TS1105/06/09 CSA requires a very low 0.68  $\mu\text{A}$  supply current, while the CSA buffered output requires a very low nominal supply current of 0.76  $\mu\text{A}$ . These CSAs are designed for high precision current measurements as the TS1109 combines a 1% gain error(MAX) with a 150  $\mu\text{V}$  VOS(MAX) while the TS1105/06 combine a 0.6% gain error(MAX) with a 100  $\mu\text{V}$  VOS(MAX). The inverting terminal of the CSA output buffer, FILT, is also made accessible so that a RC Filter can be connected to reduce noise.

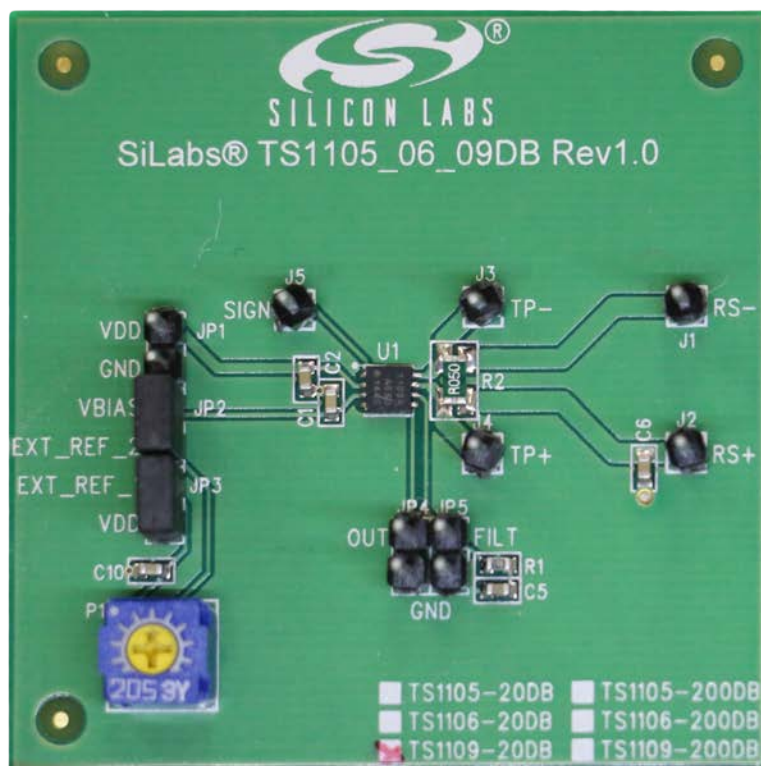
The TS1105/06/09 is fully specified to operate over the  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  temperature range and is available in a low-profile, thermally-enhanced, 8-pin 3 x 3 mm TDFN package with an exposed back-side paddle.

## KEY FEATURES

- $R_{\text{SENSE}}$ : 50 m $\Omega$   $\pm$  0.5%
- Adjustable Bias for CSA Buffer
- Compatible for Both Gain Options
  - 20 V/V
  - 200 V/V

## ORDERING INFORMATION

- TS1105-20DB
- TS1105-200DB
- TS1106-20DB
- TS1106-200DB
- TS1109-20DB
- TS1109-200DB



## 1. Description

The TS1105/06/09 Evaluation Board is intended for evaluation of the current sense amplifier plus the buffered output with adjustable bias. The evaluation board includes a variable reference scheme so that the bias voltage of the CSA buffered output can be adjusted with respect to the VDD voltage. The jumpers, JP2 and JP3, can be connected so that the included potentiometer can be used to adjust the bias voltage. The Quick Start Procedure details adjustment of the bias voltage for the CSA buffered output and measurement of the output voltage for a given load.

**Table 1.1. Component List**

Designation	Quantity	Description
U1	1	TS1105-20, TS1105-200 TS1106-20, TS1106-200 TS1109-20, TS1109-200
R1	1	4.02 k $\Omega$ $\pm$ 1%, 1/16 W (0603)
R2	1	0.05 $\Omega$ $\pm$ 0.5%, 1/2 W (1206)
C1, C6	2	1 $\mu$ F $\pm$ 10%, 10 V (0603)
C2, C10	2	0.1 $\mu$ F $\pm$ 10%, 10 V (0603)
C5	1	0.47 $\mu$ F $\pm$ 10%, 10 V (0603)
J1, J2, J3, J4	4	Header 1 x 1
J5 (TS1106 and TS1109 Only)	1	Header 1 x 1
JP1, JP2, JP3, JP4, JP5	5	Header 1 x 2
JS1, JS2	2	Jumper Shunt

## 2. Quick Start Procedure

### Required Equipment

- 3 V Power Supply or 3 V Battery
- 2 Digital Multimeters
  - 1 ammeter
  - 1 voltmeter
- Potentiometer

To use the TS1105/06/09 evaluation board, perform the following steps:

1. Configure JP3 so that the Jumper Shunt is connecting VDD to EXT\_REF\_1, and configure JP2 so that the jumper shunt is connecting V<sub>BIAS</sub> to EXT\_REF\_2.
2. Connect the 3 V power source to RS+ and VDD.
3. Use the voltmeter to measure the V<sub>BIAS</sub> voltage, and adjust P1 potentiometer so that V<sub>BIAS</sub> is 1.5 V.
4. Connect the voltmeter to measure V<sub>OUT</sub>. With no load connected, V<sub>OUT</sub> should be equal to V<sub>BIAS</sub>. The expression for the V<sub>OUT</sub> output voltage is defined by the following equations:

$$V_{OUT} = V_{VBIAS} - (GAIN \times R_{SENSE} \times |i_{SENSE}|)$$

**Equation 1. TS1105 and TS1106 Output Voltage**

$$V_{OUT} = V_{VBIAS} - (GAIN \times R_{SENSE} \times \pm i_{SENSE})$$

**Equation 2. TS1109 Output Voltage**

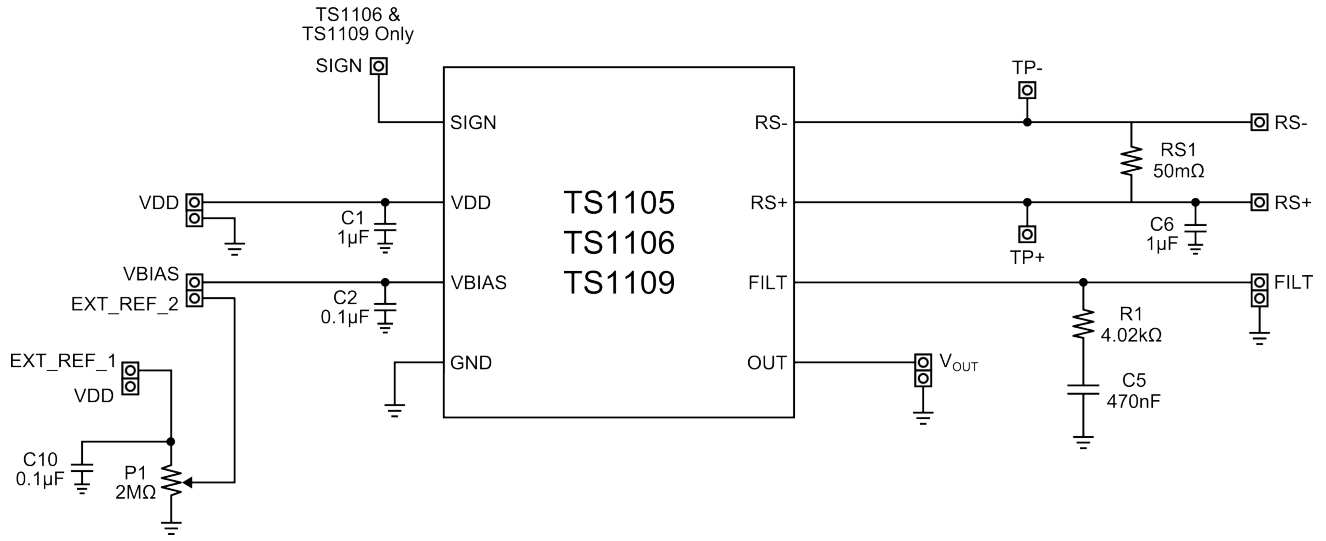
5. Connect an ammeter in series from RS– to a potentiometer. Adjust the POT until the ammeter reads:
  - TS1105/06/09-20: 500 mA
  - TS1105/06/09-200: 50 mA

V<sub>OUT</sub> should equal 1 V, and SIGN should be HIGH.

6. TS1106 and TS1109 Only: To evaluate the bidirectional functionality and observe the unipolar or bipolar CSA buffered output scheme, disconnect the 3 V power supply from RS+ and VDD, as well as the POT connected to RS–. Reconfigure the 3 V power source by connecting it to RS– and VDD. Connect the ammeter in series from RS+ to the potentiometer. Adjust the POT so that the ammeter reads the correct ILOAD value for the given part number. The SIGN output will be LOW. Confirm that the output voltage matches with the given part number.

**Table 2.1. Output Voltages by Part Number**

Part Number	I <sub>LOAD</sub>	V <sub>OUT</sub>
TS1106-20	500 mA	1 V
TS1106-200	50 mA	
TS1109-20	500 mA	2 V
TS1109-200	50 mA	



**Figure 2.1. TS1105/06/09DB Circuit Schematic**



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