

LT1999: High Voltage, Bidirectional Current Sense Amplifier

DESCRIPTION

Demonstration circuit 1698A features the LT1999, a high voltage, bi-directional current sense amplifier.

The demo board amplifies the voltage drop across an on board current sense resistor. The output voltage is a bi-directional signal that is centered on the V_{REF} voltage and is proportional to the current through the sense resistor. The output is scaled by one of three fixed gain options. The gain options are: 10V/V (DC1698A-A), 20V/V (DC1698A-B)

and 50V/V (DC1698A-C). The input voltage range is from -5V to 80V (independent of the device supply voltage) allowing the part to be used for high or low side current sensing. The LT1999 requires a separate 5V supply voltage.

Design files for this circuit board are available at <http://www.linear.com/demo>

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PERFORMANCE SUMMARY

Table 1. Performance Summary ($T_A = 25^\circ\text{C}$)

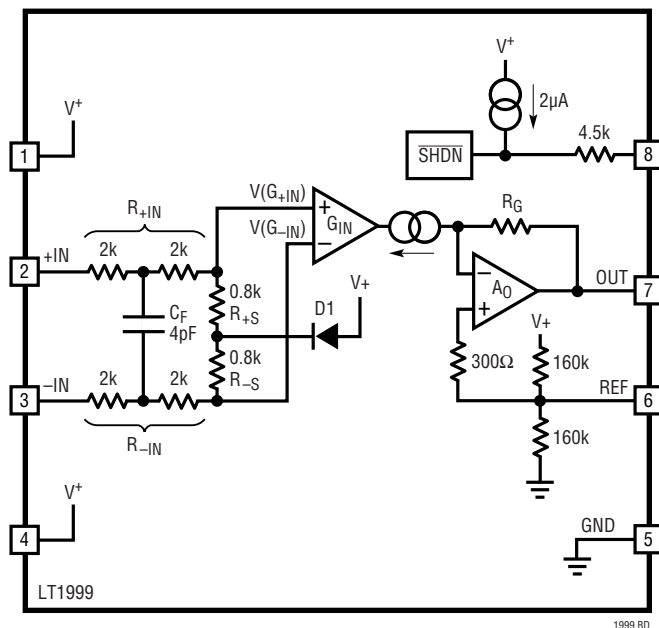
| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------|---|--|------|----------|-------------|---------------|
| V_S | Supply Range | | 4.5 | | 5.5 | V |
| V_{CM} | CM Input Voltage Range | | -5 | | 80 | V |
| CMRR | Common Mode Rejection Ratio | $V_{CM} = 0V$, $7V_{P-P}$, $f = 100\text{kHz}$ | 80 | 100 | | dB |
| V_{OUT} | Swing Output High (with Respect to V^+) Swing Output Low (with Respect to V^-) | $R_{LOAD} = \text{Open}$ $R_{LOAD} = \text{Open}$ | | 5 150 | 125 225 | mV mV |
| V_{OSI} | Input Referred Offset Voltage | $T_A = 25^\circ\text{C}$, $V_{CM} > 5.5V$ | | 550 | | μV |
| I_Q | V^+ Quiescent Current | $V_{CM} > 5.5V$ | | 1.55 | | mA |
| V_{REF} | Open Circuit Voltage | $V_S = 5V$ | 2.44 | 2.5 | 2.55 | V |
| V_{REFIN} | REF Pin Input Range | | 1.25 | | $V^+ - 1.5$ | V |

OPERATING PRINCIPLES

The LT1999 operates by amplifying the voltage drop across a user selected sense resistor. The voltage across the resistor is amplified by a fixed gain of 10V/V, 20V/V or 50V/V (LT1999-10, LT1999-20, LT1999-50) and is level

shifted to the OUT pin of the device. The voltage difference and polarity with respect to the V_{REF} pin voltage indicates the magnitude and direction of the current in the sense resistor.

BLOCK DIAGRAM



QUICK START PROCEDURE

Demonstration circuit 1698 is easy to set up and evaluate the performance of the LT1999. Refer to Figure 1 for proper measurement equipment setup and follow the procedure:

1. With power off, connect a power supply to V^+ and the common to GND. This supply should be between 4.5V and 5.5V. Connect a second supply's positive terminal to the V_{SENSE}^+ and connect its common to the circuit ground. The second supply's (load supply) output voltage can range from -5V to 80V.
2. With power off, connect the load to the V_{SENSE}^- . If the load power source does not have accurate current readout a DMM may be connected in series with the load as shown in Figure 1.
3. Connect a voltmeter to the V_{OUT} terminal, with the common connected to the V_{REF} terminal. An oscilloscope can also be used to monitor V_{out} with respect to ground.
4. Turn on the power supply to the device and the load supply.
5. Measure the output voltage with respect to V_{REF} . The output voltage will be proportional to the load and with the factory set sense resistor will equal 0.5V per 1A.

QUICK START PROCEDURE

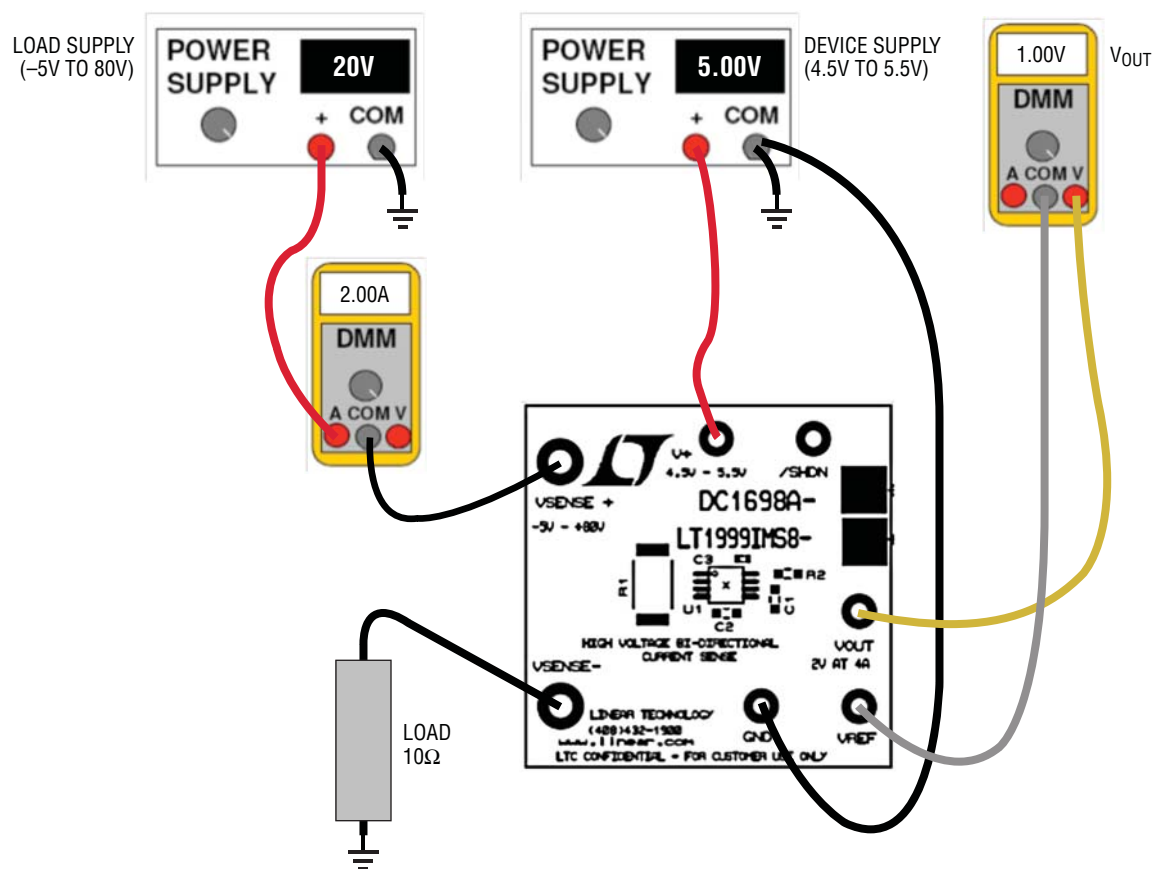


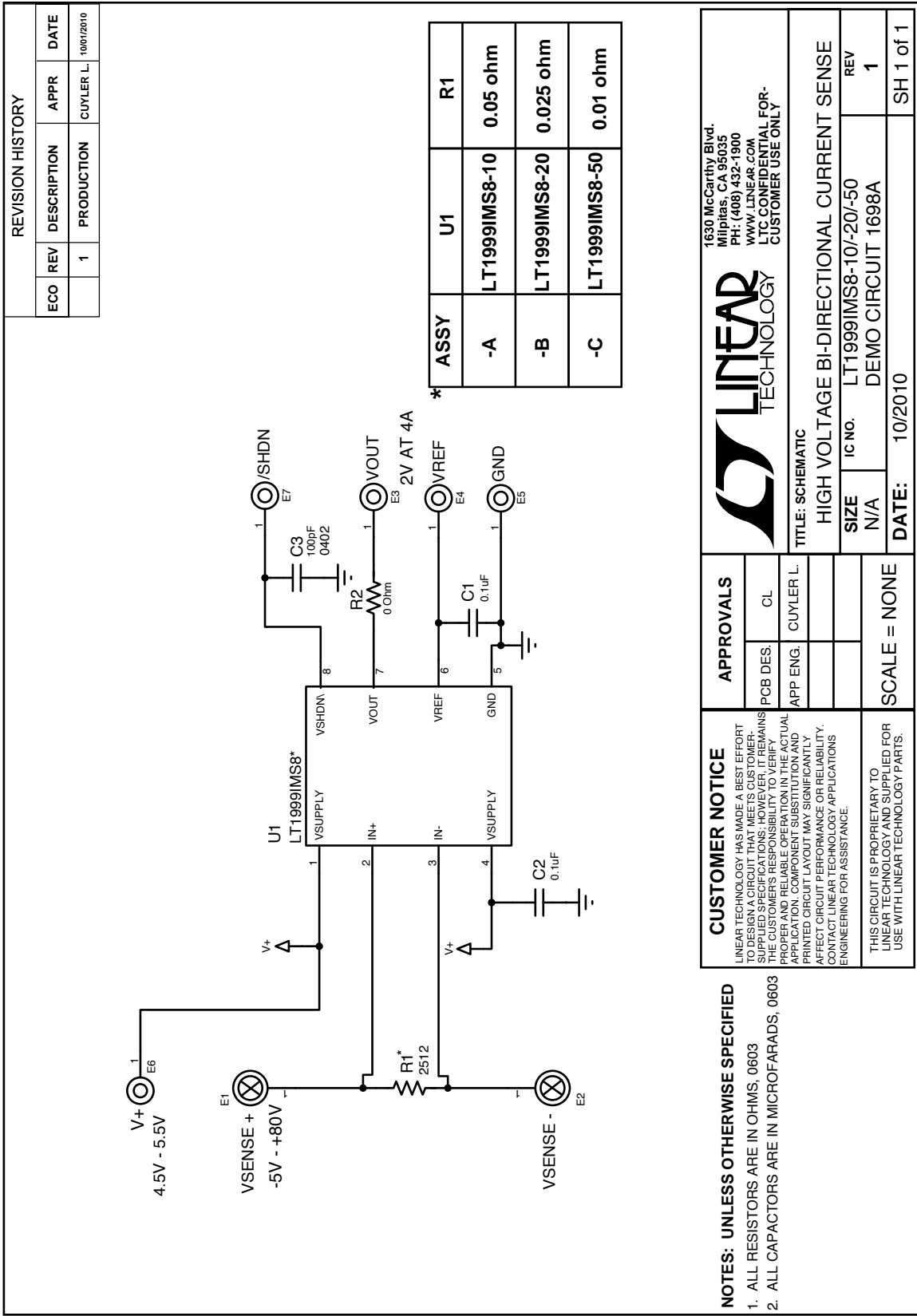
Figure 1. Proper Measurement Equipment Setup

DEMO MANUAL DC1698A

PARTS LIST

| ITEM | QUANTITY | REFERENCE | DESCRIPTION | MANUFACTURER'S PART NUMBER |
|--------------------|----------|-----------|---|--------------------------------------|
| General BOM | | | | |
| 1 | 2 | C1, C2 | Capacitor, 0.1 μ F 10% 25V X7R 0603 | AVX, 06033C104KAT2A |
| 2 | 1 | C3 | Capacitor, 100pF 10% 16V X7R 0402 | AVX, 0402YC101KAT2A |
| 3 | 1 | R2 | Resistor, 0 Ω 0603 1% 1/16W | YAGEO, RC0603FR-070RL |
| DC1698A-A | | | | |
| 1 | 1 | DC1698A | General BOM | |
| 2 | 1 | R1 | Resistor, 0.05 Ω 1% 2512 2W | SEI, CSRN2512FT50L0 |
| 3 | 1 | U1 | IC, LT1999IMS8-10 | Linear Technology, LT1999IMS8-10#PBF |
| DC1698A-B | | | | |
| 1 | 1 | DC1698A | General BOM | |
| 2 | 1 | R1 | Resistor, 0.025 Ω 1% 2512 1W | Vishay, WSL2512R0250FEA |
| 3 | 1 | U1 | IC, LT1999IMS8-20 | Linear Technology, LT1999IMS8-20#PBF |
| DC1698A-C | | | | |
| 1 | 1 | DC1698A | General BOM | |
| 2 | 1 | R1 | Resistor, 0.01 Ω 1W 1% 2512 SMD | Vishay, WSL2512R0100FEA |
| 3 | 1 | U1 | IC, LT1999IMS8-50 | Linear Technology, LT1999IMS8-50#PBF |

SCHEMATIC DIAGRAM



DEMO MANUAL DC1698A

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