

# 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 ( $T_A = 25^\circ\text{C}$ )**

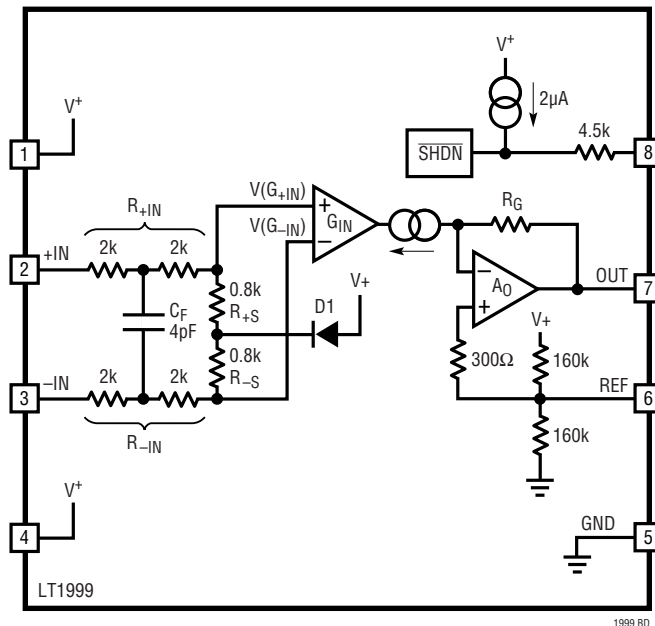
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_S$	Supply Range		4.5		5.5	V
$V_{CM}$	CM Input Voltage Range		-5		80	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = 0V$ , $7V_{P-P}$ , $f = 100\text{kHz}$	80	100		dB
$V_{OUT}$	Swing Output High (with Respect to $V^+$ ) Swing Output Low (with Respect to $V^-$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

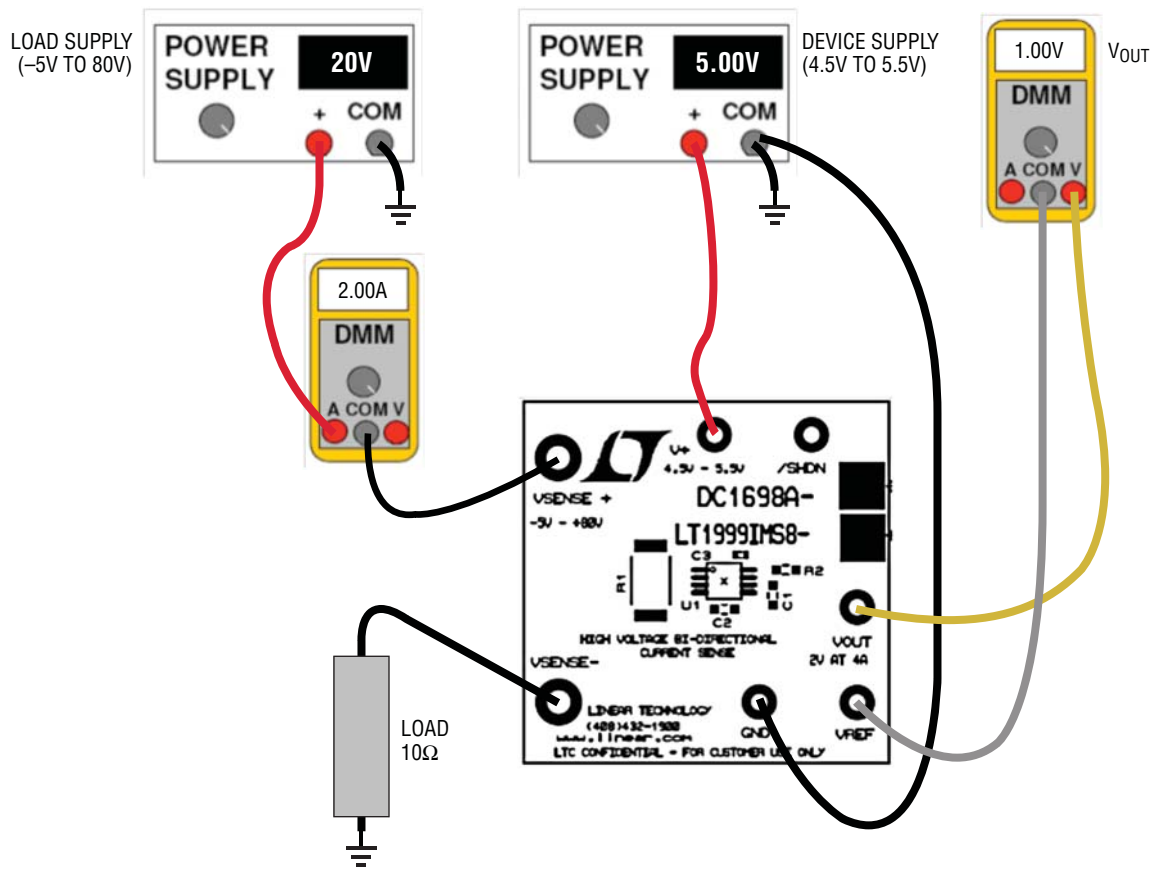


Figure 1. Proper Measurement Equipment Setup

# DEMO MANUAL DC1698A

## PARTS LIST

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

**SCHEMATIC DIAGRAM**

REVISION HISTORY				
ECO	REV	DESCRIPTION	APPR	DATE
	1	PRODUCTION	CUYLER L.	10/01/2010

ASSY	U1	R1
-A	LT1999IMS8-10	0.05 ohm
-B	LT1999IMS8-20	0.025 ohm
-C	LT1999IMS8-50	0.01 ohm

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THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		APP. ENG.	CUYLER L.
SCALE = NONE		TITLE: SCHEMATIC	

HIGH VOLTAGE BI-DIRECTIONAL CURRENT SENSE	
SIZE	REV
N/A	1
IC NO. LT1999IMS8-10/-20/-50	
DATE: 10/2010	
DEMO CIRCUIT 1698A	
SH 1 of 1	

**NOTES: UNLESS OTHERWISE SPECIFIED**

- ALL RESISTORS ARE IN OHMS, 0603
- ALL CAPACTORS ARE IN MICROFARADS, 0603

# DEMO MANUAL DC1698A

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