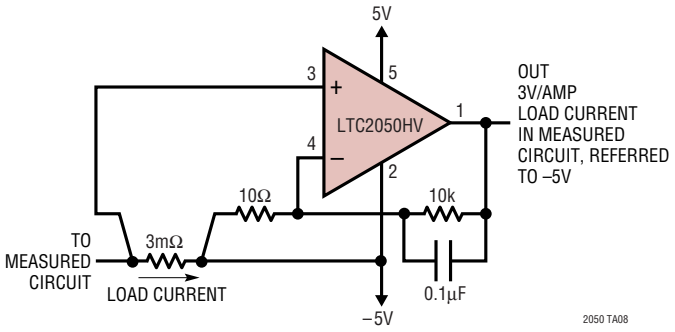
Low Side

This chapter discusses solutions for low side current sensing. With these circuits the current flowing in the ground return or negative power supply line is monitored.

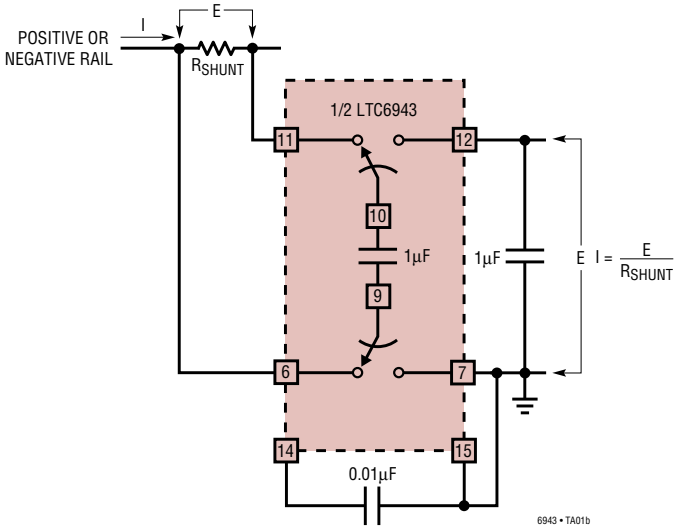
To see other chapters in this Application Note, return to the Introduction.

"Classic" High-Precision Low Side Current Sense



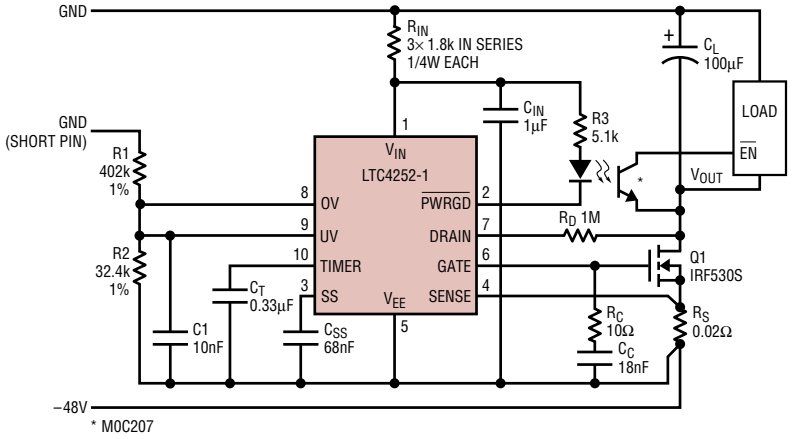
This configuration is basically a standard non-inverting amplifier. The op amp used must support common-mode operation at the lower rail and the use of a Zero-Drift type (as shown) provides excellent precision. The output of this circuit is referenced to the lower Kelvin contact, which could be ground in a single-supply application. Small-signal range is limited by V_{OL} for single-supply designs. Scaling accuracy is set by the quality of the user-selected resistors.

Precision Current Sensing in Supply Rails



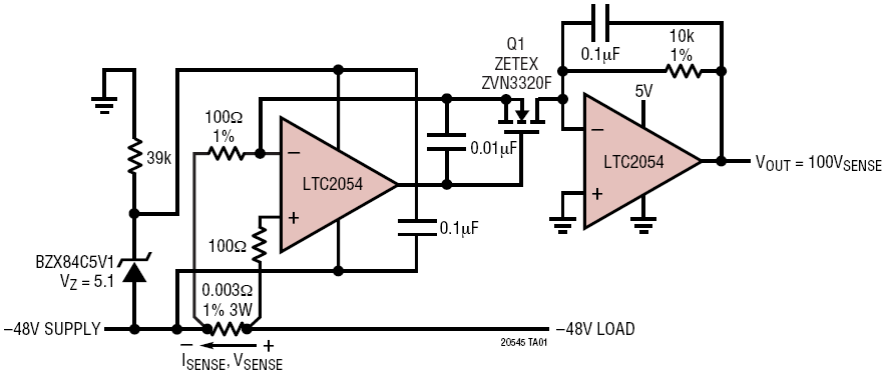
This is the same sampling architecture as used in the front-end of the LTC2053 and LTC6800, but sans op amp gain stage. This particular switch can handle up to 18V, so the ultra-high precision concept can be utilized at higher voltages than the fully integrated ICs mentioned. This circuit simply commutates charge from the flying sense capacitor to the ground-referenced output capacitor so that under dc input conditions the single-ended output voltage is exactly the same as the differential across the sense resistor. A high precision buffer amplifier would typically follow this circuit (such as an LTC2054). The commutation rate is user-set by the capacitor connected to pin 14. For negative supply monitoring, pin 15 would be tied to the negative rail rather than ground.

–48V Hot Swap Controller



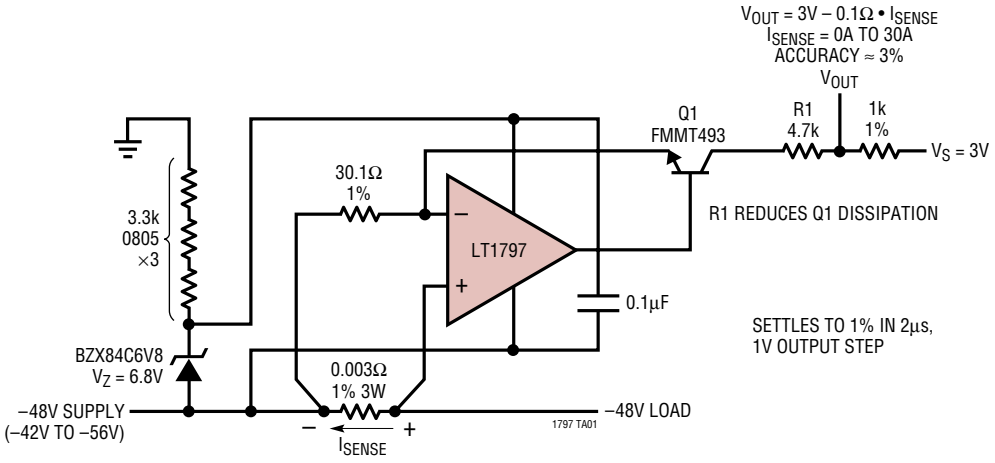
This load protecting circuit employs low-side current sensing. The N-MOSFET is controlled to soft-start the load (current ramping) or to disconnect the load in the event of supply or load faults. An internal shunt regulator establishes a local operating voltage.

–48V Low Side Precision Current Sense



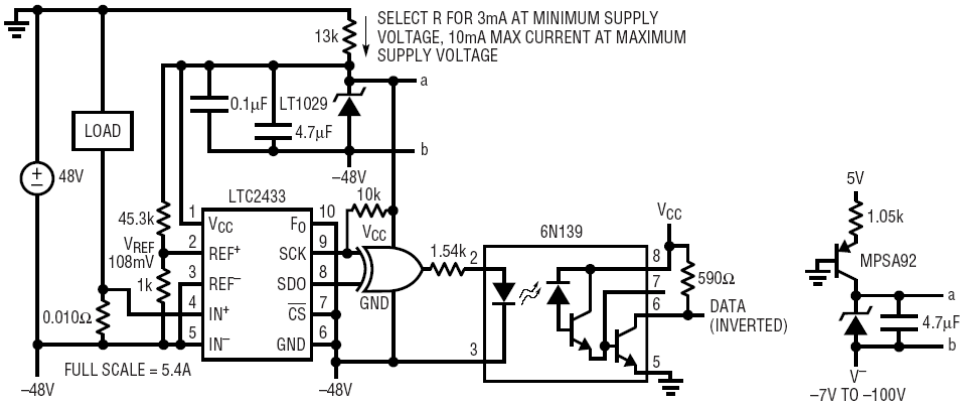
The first stage amplifier is basically a complementary form of the "classic" high-side current sense, designed to operate with telecom negative supply voltage. The Zener forms an inexpensive "floating" shunt-regulated supply for the first op amp. The N-MOSFET drain delivers a metered current into the virtual ground of the second stage, configured as a trans-impedance amplifier (TIA). The second op amp is powered from a positive supply and furnishes a positive output voltage for increasing load current. . A dual op amp cannot be used for this implementation due to the different supply voltages for each stage. This circuit is exceptionally precise due to the use of Zero Drift op amps. The scaling accuracy is established by the quality of the user-selected resistors. Small-signal range is limited by V_{OL} in single-supply operation of the second stage.

Fast Compact –48V Current Sense

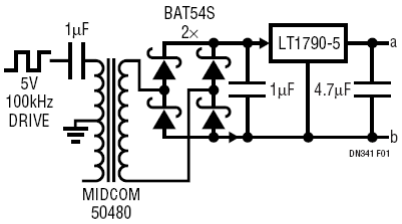


This amplifier configuration is essentially the complementary implementation to the classic high-side configuration. The op amp used must support common-mode operation at its lower rail. A "floating" shunt-regulated local supply is provided by the Zener diode, and the transistor provides metered current to an output load resistance (1kΩ in this circuit). In this circuit, the output voltage is referenced to a positive potential and moves downward when representing increasing –48V loading. Scaling accuracy is set by the quality of resistors used and the performance of the NPN transistor.

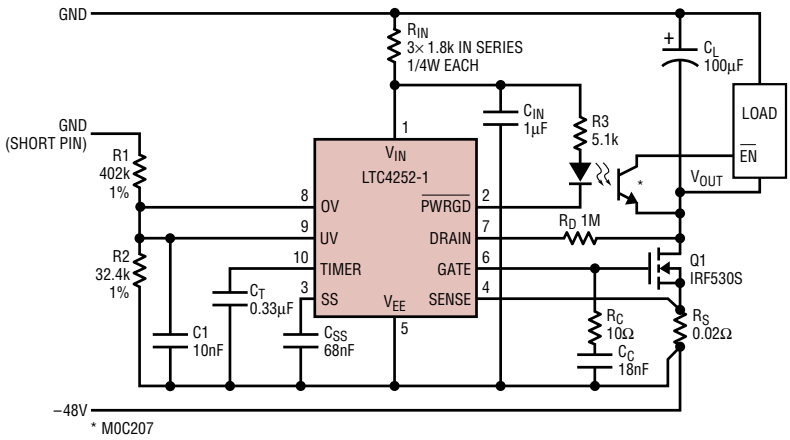
–48V Current Monitor



In this circuit an economical ADC is used to acquire the sense resistor voltage drop directly. The converter is powered from a "floating" high-accuracy shunt-regulated supply and is configured to perform continuous conversions. The ADC digital output drives an opto-isolator, level-shifting the serial data stream to ground. For wider supply voltage applications, the 13k biasing resistor may be replaced with an active 4mA current source such as shown to the right. For complete dielectric isolation and/or higher efficiency operation, the ADC may be powered from a small transformer circuit as shown below.

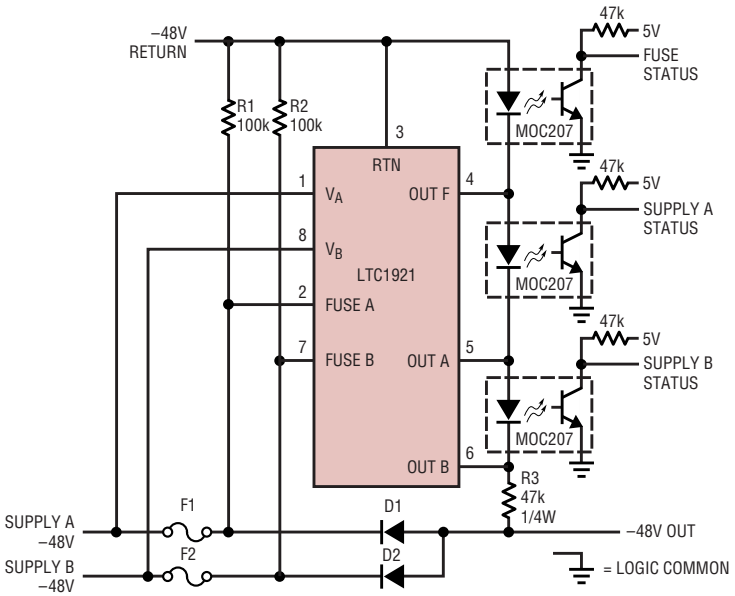


–48V Hot Swap Controller



This load protecting circuit employs low-side current sensing. The N-MOSFET is controlled to soft-start the load (current ramping) or to disconnect the load in the event of supply or load faults. An internal shunt regulator establishes a local operating voltage.

Simple Telecom Power Supply Fuse Monitor



V_A	V_B	SUPPLY A STATUS	SUPPLY B STATUS
OK	OK	0	0
OK	UV OR OV	0	1
UV OR OV	OK	1	0
UV OR OV	UV OR OV	1	1

OK: WITHIN SPECIFICATION
OV: OVERVOLTAGE
UV: UNDERVOLTAGE

$V_{FUSE\ A}$	$V_{FUSE\ B}$	FUSE STATUS
$= V_A$	$= V_B$	0
$= V_A$	$\neq V_B$	1
$\neq V_A$	$= V_B$	1
$\neq V_A$	$\neq V_B$	1*

0: LED/PHOTODIODE ON
1: LED/PHOTODIODE OFF
*IF BOTH FUSES (F1 AND F2) ARE OPEN, ALL STATUS OUTPUTS WILL BE HIGH SINCE R3 WILL NOT BE POWERED

The LTC1921 provides an all-in-one telecom fuse and supply-voltage monitoring function. Three opto-isolated status flags are generated that indicate the condition of the supplies and the fuses.