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LTC4371
Dual Negative Voltage
Ideal Diode-OR Controller

DESCRIPTION

Demonstration circuit 2180A showcases the LTC[®]4371 dual negative voltage ideal diode-OR controller and monitor, in a -48V, 50A application. Each channel includes two paralleled 2m Ω (Max) MOSFETs for a total dissipation of just 2.5W at full load. Power connections are made by way of 1/4" ring terminals with a cable capacity of 4 AWG.

Design files for this circuit board are available at <http://www.linear.com/demo/DC2180A>

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PERFORMANCE SUMMARY

 Specifications are at T_A = 25°C

Operating Limits

Operating Voltage Range	-32V to -85V
Input A or B to RTN Voltage	-100V (BV _{DSS} Limited)
Input A to Input B Voltage	±100V (BV _{DSS} Limited)
Maximum DC Load Current	50A
Peak Load Current, 100ms	100A
MOSFET Avalanche Current (I _{AS})	150A

Hardware

Cap Screw Threading	1/4 - 28
Cap Screw Allen Wrench Size	3/16"
Hex Nut Socket Size	7/16"
Ring Terminal	Panduit S4-14R
Ring Terminal Capacity	4 AWG
Recommended Cabling	Kalas Wire and Cable #4 ToughFlex Heavy Duty Welding Cable

QUICK START PROCEDURE

Overview

DANGER! HIGH VOLTAGE TESTING SHALL BE PERFORMED BY QUALIFIED PERSONNEL ONLY. AS A SAFETY PRECAUTION AT LEAST TWO PEOPLE SHALL BE PRESENT DURING HIGH VOLTAGE TESTING.

DC2180A showcases the LTC4371 dual negative voltage ideal diode-OR controller and monitor in a -48V , 50A application. $2\text{m}\Omega$ maximum, 100V MOSFETs (M1 to M4) are used (two per channel) to realize a full load drop of less than 50mV, and a loss of less than 2.5W.

Board Layout

The board comprises four layers, with planes for -48VA , -48VB , -48VOUT and RTN. These planes are replicated on each of the four layers to achieve the lowest possible resistance, minimize conduction loss and convey heat away from the power MOSFETs.

There are exposed conductors on the bottom of the board, and the heads of the cap screws protrude through the bottom of the board. The underlying surface should be non-conductive and clear of wire, solder and other conductive debris.

Current and Voltage Limitations

DC2180A is designed to deliver 50A continuous load current from any combination of current at the -48VA and -48VB inputs. If the current is concentrated in one input, the two MOSFETs in that channel will dissipate a total of slightly less than 2.5W. If the current is shared equally between both inputs the total dissipation falls to 1.25W, since with all four MOSFETs conducting the total resistance is effectively halved.

The short term current-carrying capability is limited by the MOSFET rating of 1200A pulsed at 25°C case temperature, gradually giving way to dissipation limitations for longer surges. Up to 100A load current can be easily handled for one second. See the MOSFET data sheet for further information.

The input voltage is limited by the BV_{DSS} rating of the MOSFETs to 100V. The MOSFETs can be driven into breakdown within the limits spelled out in their data sheet.

The LTC4371 V_{DD} supply is regulated by an on-chip shunt regulator at the VZ pin, and biased by $30\text{k}\Omega$ series limiting resistor, R_Z . Dissipation in R_Z and R_1 (bias resistor for LED D1) limit the maximum DC operating condition to about -90V . -85V is suggested as a conservative maximum DC input voltage, leaving margin for elevated operating temperatures and brief excursions up to the BV_{DSS} rating of the MOSFETs.

High Current Connections

Panduit S4-14R lugs are provided for connecting 50A power supplies and a 50A load. The lugs are designed for crimping to 4 AWG welding cable. A Thomas & Betts WT115 or equivalent crimper is suggested for the lugs. Other crimping methods can result in an inferior, high resistance and short-lived connection whose power dissipation contributes significantly to board temperature rise.

The importance of properly sized cabling cannot be overstated. 4 AWG welding cable exhibits a resistance of $263\mu\Omega$ per foot. The cabling in a typical bench setup can easily total 10', producing a voltage drop exceeding 100mV and a power loss of more than 6W in the cable alone. Contrast this with a voltage drop of 50mV and power dissipation of 2.5W total in the MOSFETs at 50A.

QUICK START PROCEDURE

To avoid damage to the circuit board, do not over tighten the lugs. A torque sufficient to fully compress the split washer (roughly equivalent to 400 in-oz applied to the 1/4-28 hex nut) is sufficient to produce good electrical contact. Apply DeOxit as necessary to assure clean mating surfaces. The fasteners are stainless steel and therefore subject to galling; do not over tighten. A lithium- or molybdenum disulfide-based thread lubricant is recommended for repeated assembly and disassembly.

RTN current does not pass through DC2180A. A single point connection to the RTN terminal of the load is all that is necessary to deliver bias (<5mA) to the LTC4371 and FAULTB LED.

FAULTB LED

A green LED (D1) extinguishes when ΔV_{SD} exceeds 200mV, an indication of an open MOSFET or abnormally high (>200A) load current.

Basic Test Setup

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Use a Thomas & Betts WT115 crimping tool to crimp the lugs provided to 4 AWG welding cable. Do not mash or solder the lugs. Connect two 48V, 50A power supplies and a load as shown in Figure 1. Connect DC2180A's RTN terminal to the load's RTN through a short hookup wire or test lead. Apply power and adjust the load for 50A.

The load current will smoothly transition from one supply to the other, as their output voltages are adjusted up and down relative to one another. The supplies droop share over a transition region whose width is proportional to the equivalent supply resistance.

QUICK START PROCEDURE

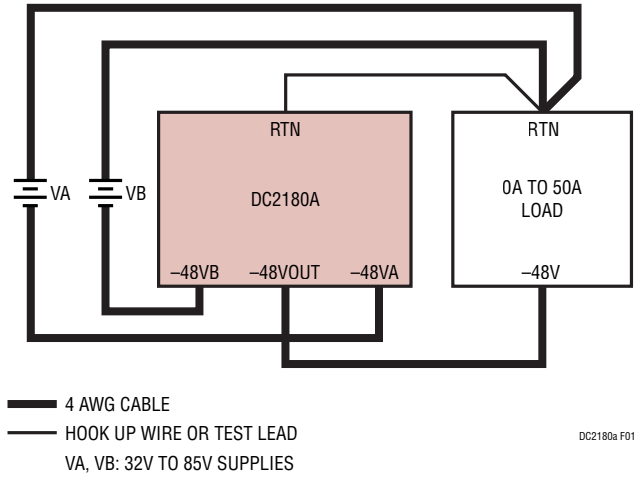
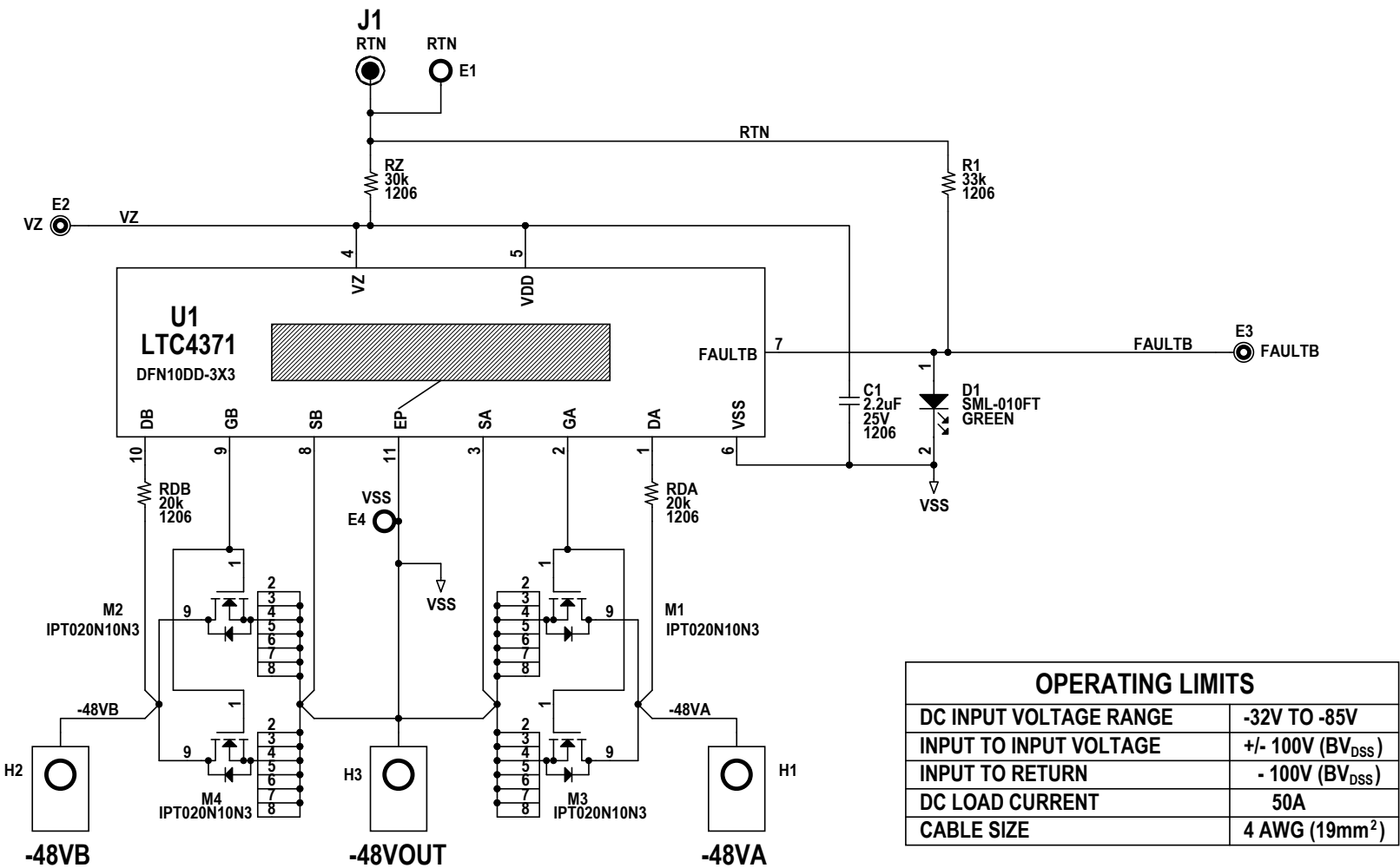


Figure 1. Test Setup

SCHEMATIC DIAGRAM



OPERATING LIMITS	
DC INPUT VOLTAGE RANGE	-32V TO -85V
INPUT TO INPUT VOLTAGE	+/- 100V (BV _{DSS})
INPUT TO RETURN	- 100V (BV _{DSS})
DC LOAD CURRENT	50A
CABLE SIZE	4 AWG (19mm ²)

DEMO MANUAL DC2180A

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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