LTC4450
18V, 12A Low Quiescent Current Ideal Diode with Shutdown Mode

DESCRIPTION

Demonstration Circuit 3001A-A showcases the LTC®4450 ideal diode controller with an integrated low $R_{DS(ON)}$ MOSFET. The board includes two independent LTC4450 ideal diodes sharing a common ground and operates over a range of 0V to 18V, carrying up to 12A. The board can be set up in a diode-OR configuration by connecting the output channels together.

Design files for this circuit board are available.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltages: VINX	Operating DC Survival	2.75 –0.3		18 20	V V
Supply Voltages: VOUTX, $\overline{SHDN}$, STATX	DC Survival	–0.3		20	V
Operating Supply Range: VCCX	Operating DC Survival	2.75 –0.3		5.5 6	V V
Operating Current Capability	2.75V ≤ VINX ≤ 18V 2.75V ≤ VCCX ≤ 5.5V			12 12	A A

BOARD PHOTO

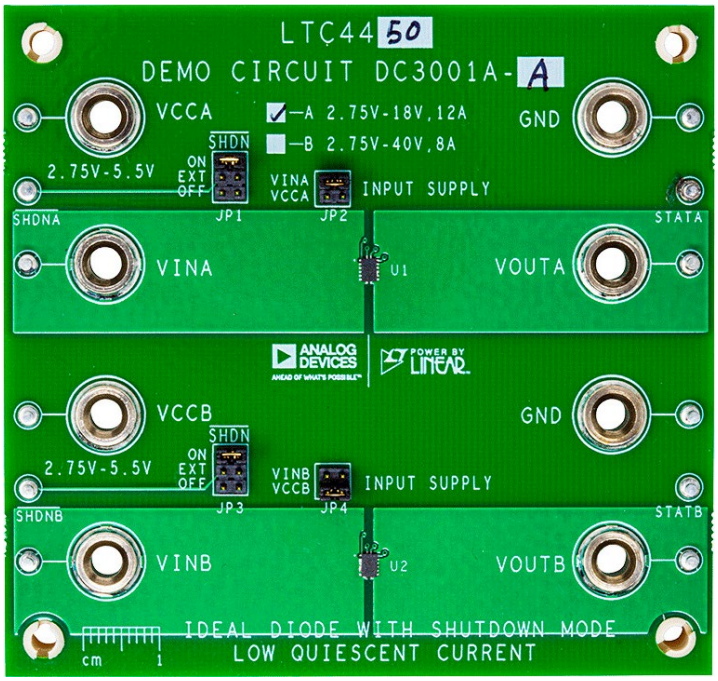

Figure 1. DC3001A Demo Board

QUICK START PROCEDURE

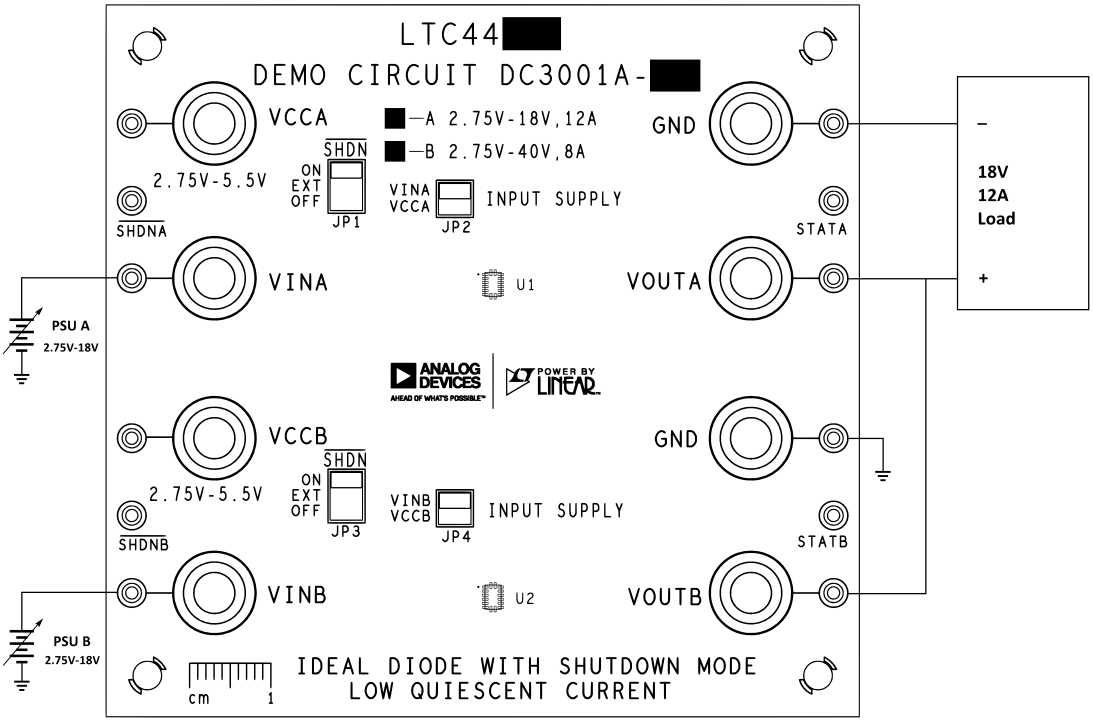

Figure 2. Basic Diode-OR Test Circuit

A simple demonstration of the DC3001A-A's operation is as follows (refer to Figure 2).

1. You will need two adjustable power supply units. Connect one supply to VINA and the nearby GND, and the other supply to VINB and GND.
2. Set both supplies to 12V.
3. Set the $\overline{\text{SHDN}}$ jumpers to ON position. Set the INPUT SUPPLY jumpers to VINX.
4. Join the outputs of VOUTA and VOUTB together. Connect the shared outputs to a constant current load, and set it to draw up to 12A.
5. Slowly adjust one supply up and down relative to the other while monitoring the power supply currents. The higher supply will carry the load current. There is a narrow transition region, where if VINA and VINB are nearly identical, the supplies will droop share.
6. Decrease the voltage on one of the supplies to 0V. Notice the output voltage does not collapse. The other supply carries the load. See Figure 3 for a scope-shot illustrating this concept.

QUICK START PROCEDURE

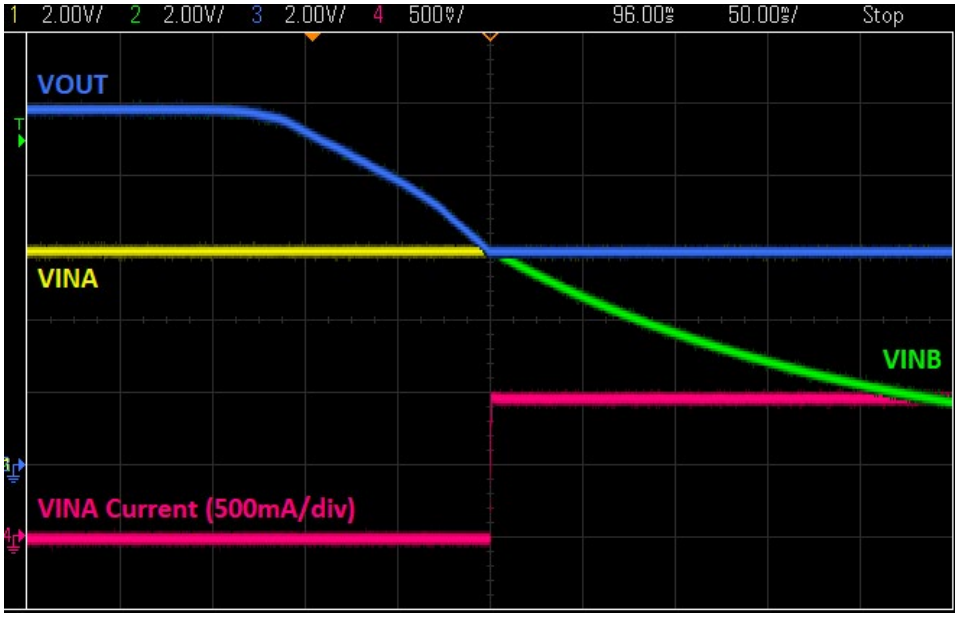

Figure 3. Diode-OR Using Figure 2. VINB's Voltage Drops, VOUT settles to VINA, which Carries the Load

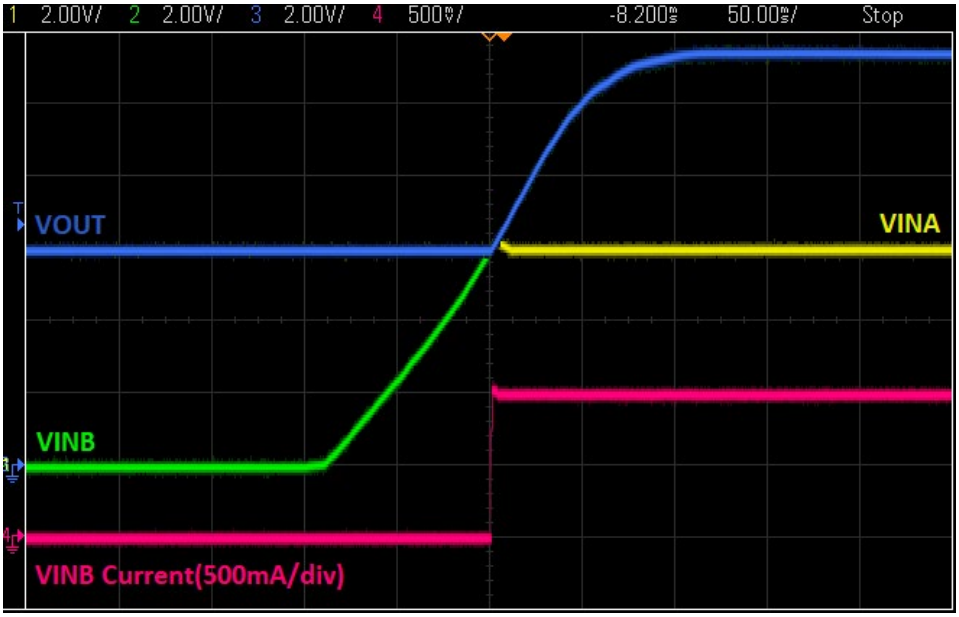

Figure 4. Diode-OR Using Figure 2. VINB ramps to Higher Voltage than VINA. VOUT Follows VINB, which Supplies Full Load Current

QUICK START PROCEDURE

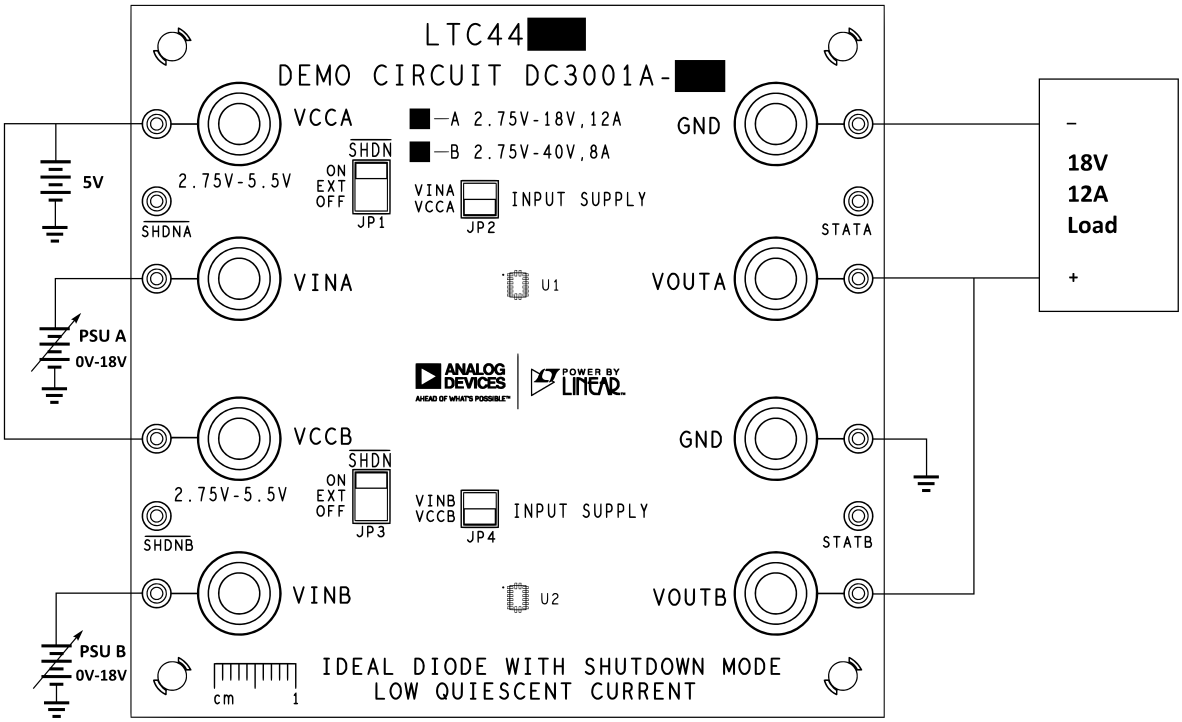

Figure 5. Separate VCC Supply for Low Voltage Operation

On Figure 5, the diode-OR test circuit from the previous exercise is configured to allow for diode operation with lower voltages on VINA and VINB. This is possible because of the separate 5V supply on VCCA and VCCB providing power to the LTC4450. Note that the INPUT SUPPLY jumpers must be changed from VINX to VCCX for this to work.

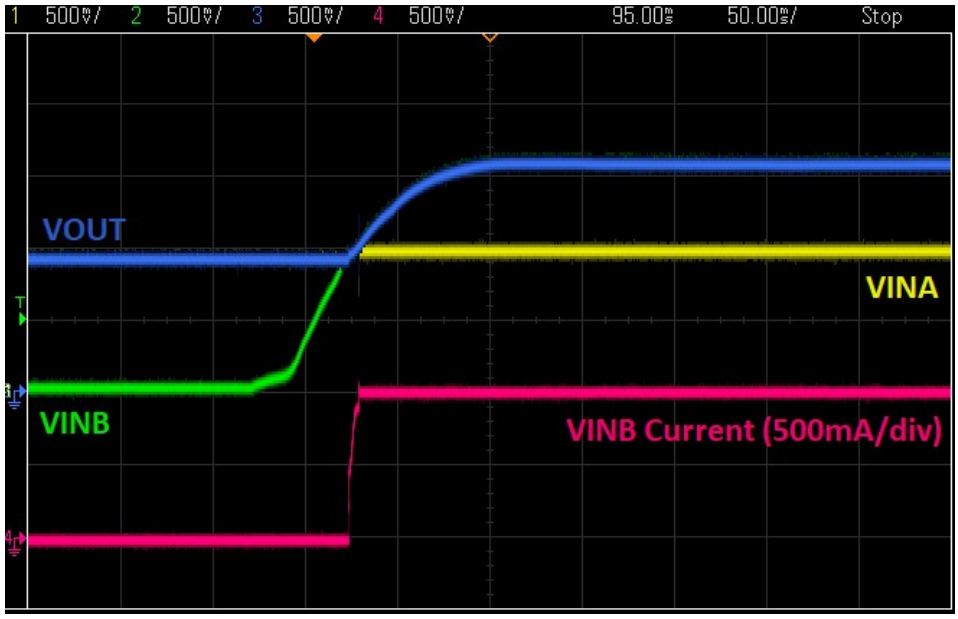

Figure 6. Low Voltage, diode-OR Using Figure 5. VINB Rises from 0V Past VINA; VOUT Follows. VINB Supplies Full Load Current

BOARD DESCRIPTION

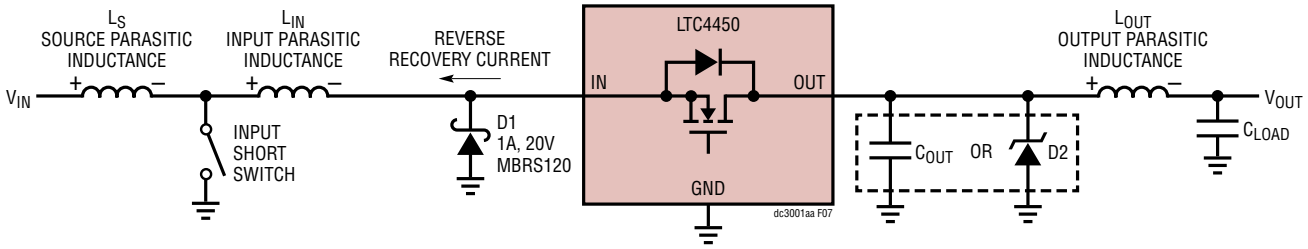

Figure 7. Input Short Protection with Parasitic Inductances

Overview

The DC3001A-A features two independent LTC4450 ideal diode circuits sharing a common ground. Each channel can handle up to 12A at room temperature with no airflow. Reference designators are duplicated for the two sections of the board; the upper section is suffixed A while the lower section is suffixed B.

Voltage and Current Capability

The internal MOSFET of the LTC4450 can safely conduct 12A at 18V in open air, provided the part is enabled. When the part is in shutdown, the internal MOSFET is turned off; however, forward current can still flow through body diode of the internal MOSFET. The LTC4450 can operate from V_{IN} = 2.75V to V_{IN} = 18V. If an application demands the LTC4450 to operate for V_{IN} below 2.75V and down to 0V, move the INPUT SUPPLY jumper to VCCX and connect an external supply greater than 2.75V to VCC.

Input Shorts

While the LTC4450 is built to withstand sudden input shorts to ground, damage may occur to the internal MOSFET under certain extreme operating conditions. In situations where parasitic inductance and the load capacitance are very large (several µH's and hundreds of µF's) IN and OUT can ring beyond their safe operating zones due to the brief window of reverse current. As an added safety measure to protect against such an event, it's recommended to connect an 18V Zener diode to the output when testing input shorts. (see Figure 7)

Shutdown

The LTC4450 may be shut down by moving the JP1 jumper to the OFF position, which ties the $\overline{SHDN}$ pin to GND. Shutdown mode reduces the quiescent current to ~1.5µA. In the ON position, the $\overline{SHDN}$ pin is tied to the V_{IN} pin, enabling LTC4450. In the EXT position, the $\overline{SHDN}$ pin is connected to the $\overline{SHDN}$ turret. It is important to note that shutting down the LTC4450 does not interrupt the forward current path. Even when the LTC4450 is in shutdown mode, the internal MOSFET body diode is still present and will conduct forward current.

BOARD DESCRIPTION

EXTERNAL CONNECTIONS

GND (2 Turrets, 2 Banana Jacks): Main ground reference of the board. All connections are made directly to the ground plane.

VINA (1 Turret, 1 Banana Jack): Input voltage connection for the LTC4450 located on the upper section of the board. Power can be supplied to the LTC4450 from this input by setting JP2 to VINA.

VINB (1 Turret, 1 Banana Jack): Input voltage connection for the LTC4450 located on the lower section of the board. Power can be supplied to the LTC4450 from this input by setting JP4 to VINB.

VCCA (1 Turret, 1 Banana Jack): Input voltage connection for the LTC4450 located on the upper section of the board. JP2 jumper should be set at VCCA for this turret and banana jack to make a connection with the V_{CC} pin of the LTC4450. VCCA is the separate power connection for the LTC4450, which allows diode operation down to 0V on VINA.

VCCB (1 Turret, 1 Banana Jack): Input voltage connection for the LTC4450 located on the lower section of the board. JP4 jumper should be set at VCCB for this turret and banana jack to make a connection with the V_{CC} pin of the LTC4450. VCCB is the separate power connection for the LTC4450, which allows diode operation down to 0V on VINB.

VOUTA (1 Turret, 1 Banana Jack): Output voltage connection for the LTC4450 located on the upper section of the board.

VOUTB (1 Turret, 1 Banana Jack): Output voltage connection for the LTC4450 located on the lower section of the board.

$\overline{\text{SHDNA}}$ (1 Turret): Shutdown digital control input. Driving this pin below 400mV disables the internal MOSFET of U1 and enters the part into a low I_Q state. When driven low, a connection from IN to OUT still exists through the internal body diode.

$\overline{\text{SHDNB}}$ (1 Turret): Shutdown digital control input. Driving this pin below 400mV disables the internal MOSFET of U2 and enters the part into a low I_Q state. When driven low, a connection from IN to OUT still exists through the internal body diode.

STATA (1 Turret): Gate status output pin for the circuit located on the upper section of the board. STATA pulls low when the gate of the N-Channel MOSFET is pulled low indicating that the LTC4450 operates in reverse bias or in Shutdown. Otherwise, STATA pulls high, indicating that the LTC4450 is operating in forward bias.

STATB (1 Turret): Gate status output pin for the circuit located on the lower section of the board. STATB pulls low when the gate of the N-Channel MOSFET is pulled low indicating that the LTC4450 operates in reverse bias or in Shutdown. Otherwise, STATB pulls high, indicating that the LTC4450 is operating in forward bias.

BOARD DESCRIPTION

JUMPER SETTINGS

JP1 (Default Setting: ON): Controls the $\overline{SHDN}$ pin state for the LTC4450 circuit located on the upper section of the board. This jumper can be set to:

1. ON, which pulls up the $\overline{SHDN}$ pin to VINA and turns on the MOSFET whenever VINA is present.
2. EXT, to facilitate an external connection via $\overline{SHDNA}$ turret.
3. OFF, which pulls down the $\overline{SHDN}$ pin to GND and switches off the MOSFET (body diode of the MOSFET will still conduct current).

JP2 (Default Setting: VINA): Controls the V_{CC} pin state for the LTC4450 circuit located on the upper section of the board. This jumper can be set to:

1. VCCA, which will connect the V_{CC} pin of the IC to the VCCA banana jack and turret, where this pin can be driven using an external power supply. This enables diode operation down to 0V.
2. VINA, which connects the V_{CC} pin of the IC to ground.

JP3 (Default Setting: ON): Controls the $\overline{SHDN}$ pin state for the LTC4450 circuit located on the lower section of the board. This jumper can be set to:

1. ON, which pulls up the $\overline{SHDN}$ pin to VINB and turns on the MOSFET whenever VINB is present.
2. EXT, to facilitate an external connection via $\overline{SHDNB}$ turret.
3. OFF, which pulls down the $\overline{SHDN}$ pin to GND and switches off the MOSFET (body diode of the MOSFET will still conduct current).

JP4 (Default Setting: VINB): Controls the V_{CC} pin state for the LTC4450 circuit located on the lower section of the board. This jumper can be set to:

1. VCCB, which will connect the V_{CC} pin of the IC to the VCCB banana jack and turret, where this pin can be driven using an external power supply. This enables diode operation down to 0V.
2. VINB, which connects the V_{CC} pin of the IC to ground.

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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