LTC4376
28V, 7A Ideal Diode and Switch with Reverse Input Protection

DESCRIPTION

Demonstration circuit 2706A showcases the LTC®4376 ideal diode controller with integrated MOSFET and –40V reverse input protection. The board showcases the high side switch functionality of the LTC4376 by utilizing an additional switch MOSFET in conjunction with the GATE pin of the device. The LTC4376 has a current capability of 7A. The board includes two independent LTC4376 ideal diode circuits sharing a common ground and operating over a range of 4V to 40V.

Design files for this circuit board are available.

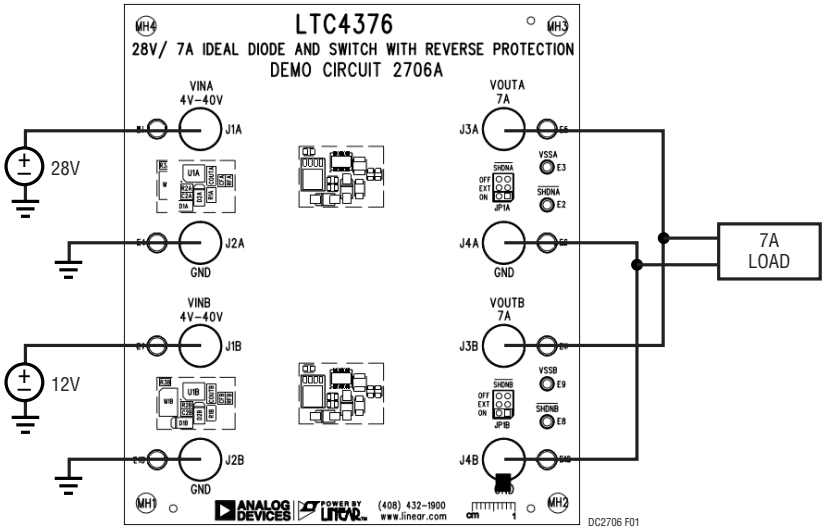

Figure 1. Basic Test Setup

EXTERNAL CONNECTIONS

Signal connections are made via the row of turret posts along the edges of the board.

GND (4 turrets, 4 Banana Jacks): These connections are made directly to the ground planes.

VINA (1 Turret, 1 Banana Jack): Input voltage connection for the LTC4376 circuit located on the upper section of the board.

VINB (1 Turret, 1 Banana Jack): Input voltage connection for the LTC4376 circuit located on the lower section of the board.

VOUTA (1 Turret, 1 Banana Jack) : Output voltage connection for the LTC4376 circuit located on the upper section of the board.

VOUTB (1 Turret, 1 Banana Jack) : Output voltage connection for the LTC4376 circuit located on the lower section of the board.

VSSA: Connection to chip ground for the LTC4376 circuit located on the upper section of the board.

VSSB: Connection to chip ground for the LTC4376 circuit located on the lower section of the board.

Jumper Settings

JP1A: Controls the $\overline{\text{SHDN}}$ pin state for the LTC4376 circuit located on the upper section of the board. This jumper can be set to OFF to pull down on the GATE pin of the LTC4376 (body diode will still conduct current to output), EXT to make an external connection (by default the $\overline{\text{SHDN}}$ pin is pulled high internally) and ON which pulls up the $\overline{\text{SHDN}}$ pin to turn the LTC4376 on. As there is an external series switch MOSFET present on the DC2706A, the $\overline{\text{SHDN}}$ pin allows the LTC4376 to operate as a switchable diode.

JP1B: Controls the $\overline{\text{SHDN}}$ pin state for the LTC4376 circuit located on the lower section of the board. This jumper can be set to OFF to pull down on the GATE pin of the LTC4376 (body diode will still conduct current to output), EXT to make an external connection (by default the $\overline{\text{SHDN}}$ pin is pulled high internally) and ON which pulls up the $\overline{\text{SHDN}}$ pin to turn the LTC4376 on. As there is an external series switch MOSFET present on the DC2706A, the $\overline{\text{SHDN}}$ pin allows the LTC4376 to operate as a switchable diode.

QUICK START PROCEDURE

Overview

DC2706A features two independent LTC4376 ideal diode circuits sharing a common ground. Each channel handles up to 7A at room temperature with no air flow and can be independently controlled, to turn ON or OFF, with the use of the $\overline{\text{SHDN}}$ pin due to the series switch MOSFET. The board is double-sided. 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 voltage capability of DC2706A is clearly stated on the top side silkscreen and on the schematic. The internal MOSFET of the LTC4376 has a 40V BVDSS rating and hence must be protected against unwanted voltage excursions beyond that range.

The LTC4376 is designed to carry 7A provided that it is enabled. When the part is disabled, the internal MOSFET is turned off, however forward current can still flow through the 0.7V body diode of the internal MOSFET. To allow full ON/OFF control of current, the LTC4376 has a GATE pin that can be used to control a series switch MOSFET. This configuration is showcased on the DC2706A.

Shutdown

The LTC4376 may be shut down by moving the JP1 jumper to the OFF position, which pulls $\overline{\text{SHDN}}$ to VSS through 100kΩ (RF). Shutdown reduces the quiescent

QUICK START PROCEDURE

current to ≈9µA. In the ON position, the $\overline{SHDN}$ pin is pulled up to VIN, enabling the LTC4376. In the EXT position, the $\overline{SHDN}$ pin is connected through RF to the $\overline{SHDN}$ turret. If the $\overline{SHDN}$ turret is left open, an internal 3µA pull up asserts it high and the LTC4376 is enabled. To disable, connect the $\overline{SHDN}$ turret to the neighboring VSS turret. $\overline{SHDN}$ pin level shift circuits are shown in the data sheet. Because the $\overline{SHDN}$ pin is high impedance, it is subject to capacitive coupling. A 10nF noise bypass capacitor, CF, works with RF to keep noise out of the $\overline{SHDN}$ pin. RF also helps protect the $\overline{SHDN}$ pin against inadvertent overvoltage conditions that might arise from use of the $\overline{SHDN}$ turret. It is important to note that if the switch MOSFET (M1) is removed, then shutting down the LTC4376 does not interrupt the forward current path. Even when the LTC4376 is in the shutdown state, the internal MOSFET body diode is still present and will conduct forward current if no series switch MOSFET is present to block current flow.

How to Operate DC2706A

A simple demonstration of DC2706A's operation is as follows (see Figure 1). Connect two adjustable power supplies, each set to 12V. Connect one to VINA and nearby GND, the second to VINB and its associated GND. Place the $\overline{SHDN}$ jumpers in the ON position. Join the outputs of VOUTA and VOUTB together at the input of a DC load of up to 7A. Slowly adjust one power supply up and down relative to the other while monitoring the power supply currents. The higher supply will carry the load current, with a narrow transition region where the voltages are nearly identical and the supplies droop share. If one supply is shorted, the output voltage will not collapse—the other supply will carry the load.

The switch functionality of the device can also be demonstrated. Set VINA to 28V and VINB to 12V with both JP1 jumpers set to the ON position. The LTC4376 will operate as a diode and will allow conduction of the 28V rail while blocking current flow to the 12V power supply. Setting JP1A to OFF will turn off channel A and disconnect the 28V from the output. As a result, the output will drop down to the 12V VINB rail.

The internal MOSFET has a breakdown voltage of 40V. This board is designed to operate at 28V. When performing input short tests at +24V, use the following circuit (Figure 2) to ensure that the internal MOSFET does not break down. C_{SNUB}, D6 and R_{SNUB} serve to protect against inductive transients that may exceed 40V breakdown of the internal MOSFET.

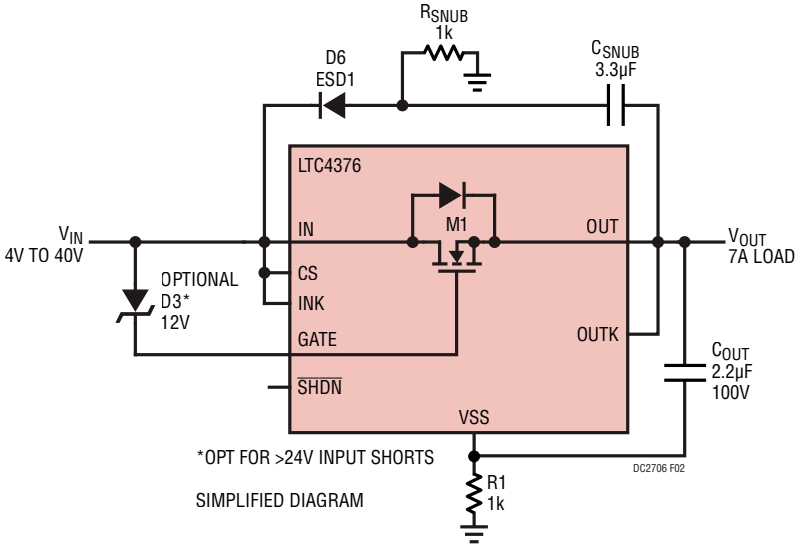

Figure 2. Protection Against Inductive Transients

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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