

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.

All registered trademarks and trademarks are the property of their respective owners.

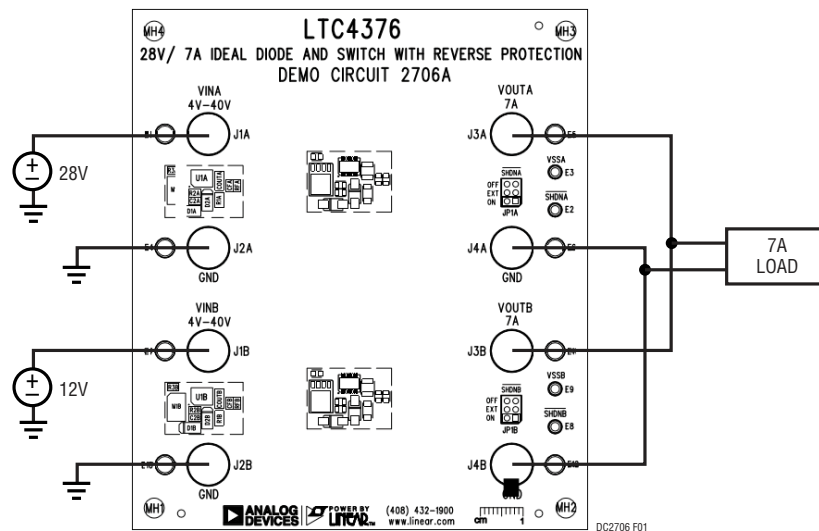


Figure 1. Basic Test Setup

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 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 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 100k Ω (RF). Shutdown reduces the quiescent

QUICK START PROCEDURE

current to $\approx 9\mu\text{A}$. In the ON position, the $\overline{\text{SHDN}}$ pin is pulled up to V_{IN} , enabling the LTC4376. In the EXT position, the $\overline{\text{SHDN}}$ pin is connected through RF to the $\overline{\text{SHDN}}$ turret. If the $\overline{\text{SHDN}}$ turret is left open, an internal $3\mu\text{A}$ pull up asserts it high and the LTC4376 is enabled. To disable, connect the $\overline{\text{SHDN}}$ turret to the neighboring VSS turret. $\overline{\text{SHDN}}$ pin level shift circuits are shown in the data sheet. Because the $\overline{\text{SHDN}}$ pin is high impedance, it is subject to capacitive coupling. A 10nF noise bypass capacitor, C_{F} , works with RF to keep noise out of the $\overline{\text{SHDN}}$ pin. RF also helps protect the $\overline{\text{SHDN}}$ pin against inadvertent overvoltage conditions that might arise from use of the $\overline{\text{SHDN}}$ 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 V_{INA} and nearby GND, the second to V_{INB} and its associated GND. Place

the $\overline{\text{SHDN}}$ jumpers in the ON position. Join the outputs of V_{OUTA} and V_{OUTB} 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 V_{INA} to 28V and V_{INB} 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 V_{INB} 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.

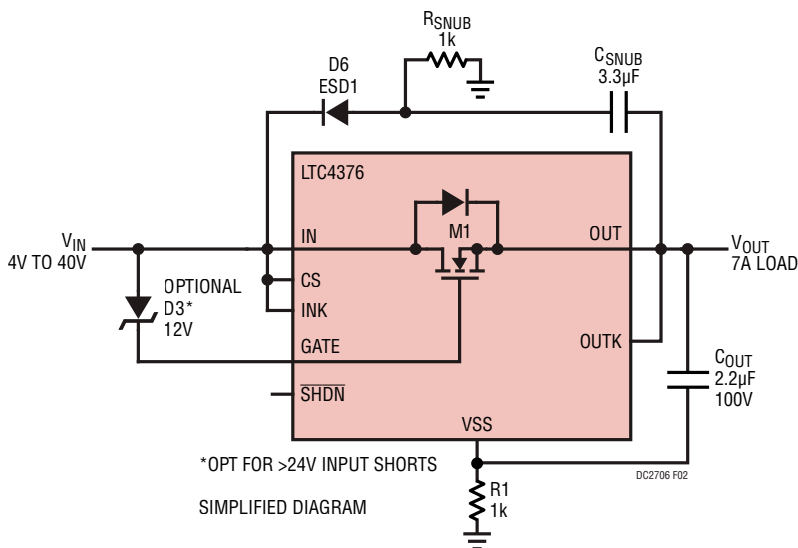


Figure 2. Protection Against Inductive Transients

DEMO MANUAL DC2706A



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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

Rev 0

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Analog Devices Inc.:](#)

[DC2706A](#)