DT0001
Design tip

Speed control using the L6235 or L6229 with a PWM output from a microcontroller

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Main components	
L6235, L6229	DMOS driver for three-phase brushless DC motor

Purpose and benefits

A simple implementation of speed and direction control of a BLDC motor is described in this note. This is achieved through an alternate use of the direction control input pin of the L6235 and L6229 when a microcontroller is doing the speed regulation in voltage mode. The advantage is that this solution uses only digital inputs and outputs of the microcontroller and it does not need to generate an analog current control command and that voltage mode typically has better load response than current mode control.

The analog current control loop in the L6235 and L6229 is used for the torque limit in this example.

Description

A simple way to interface the L6235 to a microcontroller is to connect the FWD/REV pin of the L6235 to a counter timer configured as a PWM output, as shown in figure 1.

In this configuration, the PWM controls both speed and direction. A PWM duty cycle of greater than 50% will cause the motor to run forward and a duty cycle of less than 50% will cause the motor to run in the reverse direction.

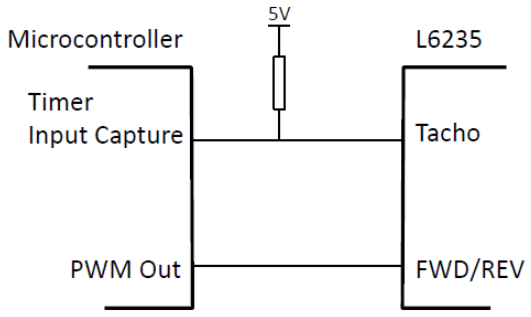

Figure 1. Connecting a L6235 to a Microcontroller

Of the three digital pins available, the FWD/REV input may not be the obvious choice for implementing the speed control, but it turns out to be a very effective choice. The BRAKE command places the output in a state with all three lower transistors turned on and is not appropriate for a speed control. One could use the enable input but you would need to have two signals from the microcontroller, the PWM for speed and the direction input. This approach is more cumbersome when crossing zero speed and reversing direction.

Analyzing the operation of the FWD/REV input, we find that it operates quite well as speed and direction input. For any fixed pattern on the hall effect inputs, the output turns on one upper and one lower transistor. If there is no change on the hall effect inputs, you are effectively working with a simple H-bridge, like driving a DC motor, and changing the FWD/REV input reverses the bridge. So in the same way that reversing the bridge in a DC motor can be used as to control a DC motor, applying the PWM to the FWD/REV input can be used for the brushless DC motor. This configuration also allows full four quadrant operation.

This configuration also allows the implementation of a position servo, if an encoder or other position sensor provides the position feedback. In this case, when the position loop is closed to hold position a full four quadrant control is achieved by simply modulating the duty cycle around the 50% point.

The maximum motor current can be limited by setting a fixed reference on the reference input for the on chip current regulator. This allows the designer to set a maximum current that effectively sets a maximum torque limit for the application, independently from the speed control loop.

For speed control, the tacho output from the L6235 can be connected to the input capture pin of a second timer channel, as shown in Figure 1, to provide the speed information (actually the period of one electrical cycle) to the microcontroller. However, this configuration provides only one update to the speed regulator every rotation (for a two pole motor). By connecting the hall effect signals to both the L6235 and the inputs to the microcontroller as shown in Figure 2, and looking at both the rising and falling edge of the three signals, you can get 6 updates every rotation. The increased feedback can be very important for low speed applications. Some microcontrollers, like the STM32, have timer channels that can be configured to do the exclusive OR of the three signals to automatically get a signal for all six edges.

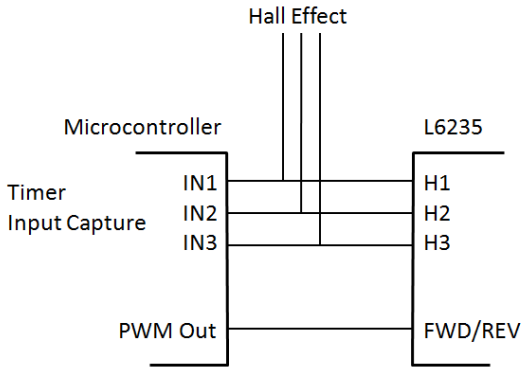

Figure 2: Improved speed feedback

Support material

Related design support material
Product/ System evaluation boards EVAL6235N, three-phase brushless DC motor driver demonstration board EVAL6235PD, three-phase brushless DC motor driver demonstration board
Documentation
Datasheets L6235, DMOS driver for three-phase brushless DC motor L6229, DMOS driver for three-phase brushless DC motor
Data Brief: EVAL6235PD: L6235 three-phase brushless DC motor driver demonstration board
Application Notes: AN1625: L6235 three phase brushless DC motor driver AN3134: EVAL6229QR demonstration board using the L6229Q DMOS driver for a three-phase BLDC motor control application
Schematics: EVAL6235N schematic EVAL6235PD schematic EVAL6229PD schematic

Revision history

Date	Version	Changes
01 Apr 2012	1	Initial release

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