AN1304
APPLICATION NOTE

USING THE TD340 : H-BRIDGE DRIVER FOR DC-MOTOR CONTROL

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INTRODUCTION

The TD340 is a quad N-Channel Power MOSFET Driver suitable for DC-Motor control. TD340 main features are:

- ❑ Speed and direction control
- ❑ Internal charge pump for high side drive
- ❑ Overvoltage and undervoltage protection
- ❑ Synchonous rectification
- ❑ Active reverse battery protection
- ❑ Inaudible 25kHz PWM frequency
- ❑ Standby mode
- ❑ Integrated 5V regulator for µC supply
- ❑ Integrated reset and watchdog circuits

This note presents some application hints:

- ❑ Zero current standby mode,
- ❑ Current limitation,
- ❑ Autoprotected H-bridge.

ZERO CURRENT STANDBY

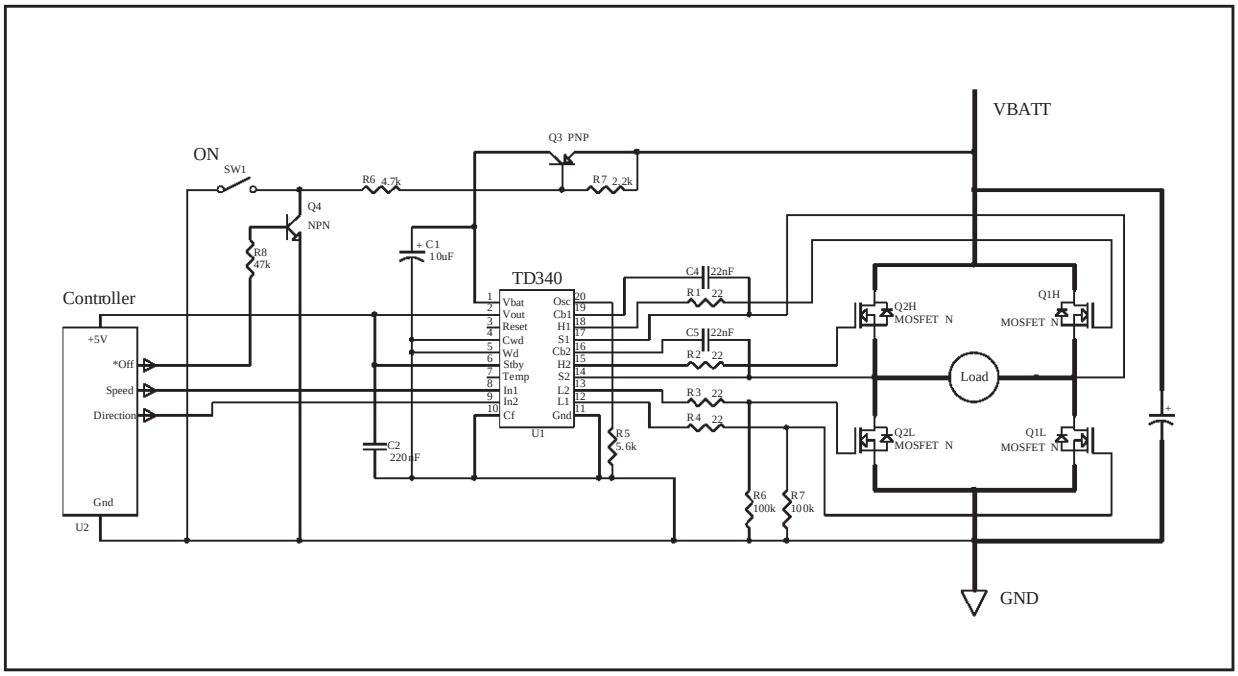
In some application, the standby current of the TD340 (180uA typ.) is still too high regarding the requirement. To achieve a true zero current standby mode, the schematic shown on figure 1 can be used by the means of only two lost cost bipolar transistors.

When the system is idle, transistor Q3 blocks the supply voltage. When the user press the command switch SW1, Q3 is activated and provides the power supply to the TD340. The µC wakes up and locks the supply by switching on transistor Q4. SW1 should be maintained long enough to allow the TD340 to start and the µC to wakeup, this time depends on the configuration and is usually about 100 ms. When the task is complete, Q4 is switched off by the µC (in the meantime, SW1 has been released), and Q3 returns to the off state.

TD340 standby mode is no more used and the STBY pin is wired to 5V (VOUT pin)

To improve the reliability of the system during power up and down, resistors can be added on the gates of the lower MOSFETs to ensure that the bridge remains off. Pull-down resistors must not be used on upper MOSFET gates, because the charge pump is not able to provide the necessary current.

Figure 1 : Zero Current Standby Circuit



CURRENT LIMITATION

Many applications need to limit the maximum current through the load. Limiting the current through a motor actually limits the torque. Figure 3 shows a solution using a TS922A, a dual low offset (0.9mV), rail-to-rail op-amp. This scheme can be used with analog or digital IN1 mode.

When the current measured through the shunt resistor placed in the bottom of the bridge becomes higher than the reference, the output of a comparator is pulled low and brings the IN1/IN2 inputs (that set the PWM ratio and the motion direction) near to ground, stopping the PWM signal and breaking the motor. The diodes D1/D2 are used to isolate the comparator output from IN1/IN2 when the current is lower than the threshold .

Op-amp U3A is used to amplify the voltage Vsense across the shunt resistor. Voltage at the output of U3A is:

Vcur=Vsense * (R9+R10) / R10

Op-amp U3B is used as a comparator. The reference level is set by the resistors R9, R10:

Vref= 5V * R12/(R11+R12).

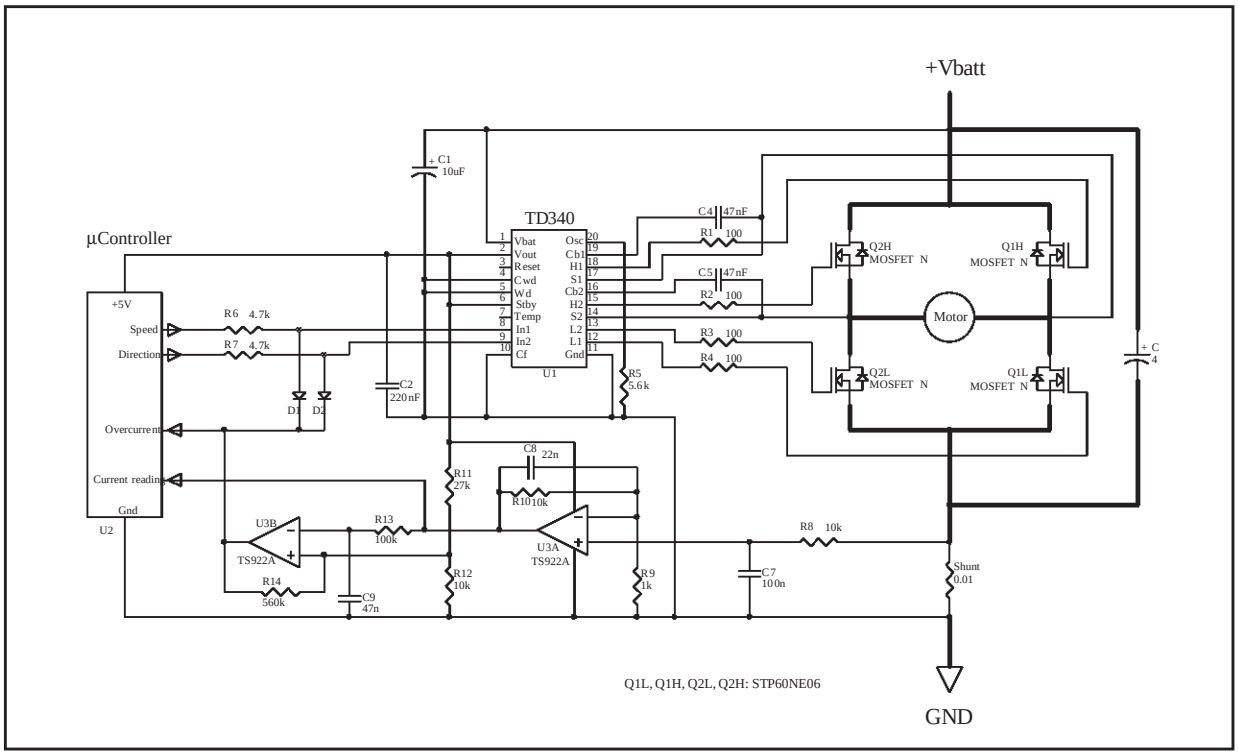
A small positive feedback is provided by the resistor R14 to add a little amount of hysteresis to the comparator.

The output of the comparator is also used to tell the microcontroller that an overcurrent event has occured. The microcontroller can then lower the PWM level.

A R8-C7 network is used to filter the current waveform. This current is actually switched at the PWM frequency (about 25kHz). A good rule is to filter at least at a frequency 10 times less than the PWM frequency. For 25kHz, R=10k and C=100nF lead to about 1kHz filtering. The shunt value must be small enough to avoid useless dissipation. A voltage drop of about 200mV is adequate.

For a full discussion and other methods, see Application Note AN1305: Current Measurement and Limitation in TD340 Based Motor Control Systems.

Figure 2 : Current Limitation



AUTOPROTECTED H-BRIDGE

Instead of using a current limiting circuit, an autoprotected full bridge can be built with two OMNIFETs. These devices, part of the ST VIPower family, provide current limiting and thermal shunt-down. OMNIFETs can be used as standard MOSFETs with the exception of a small current in the gate input. Therefore, they should be used only for low side. MOSFETs in high side should be rated to higher currents, so the protection against overcurrent and overtemperature is provided by the OMNIFETs. Figure 3 illustrates an application of these devices. OMNIFETs VND14NV04 limit the current to 14A maximum, and the upper MOSFETs STD30NE06L (30A) are protected. Note that resistor bridge are used for driving the OMNIFETs, due to their lower gate voltage capability.

Figure 3 : Autoprotected H-bridge