DN1157
Electronic Cigarette (eCig) Design Note

Background

The electronic cigarette (eCig) industry has grown dramatically over the last few years and the growth is expected to continue. Higher power eCigs require voltage and current control from an MCU and power switching using MOSFETs and gate drivers. In an eCig driver, the voltage may need to be stepped up (boost) or stepped down (buck). Figure 1 shows a typical boost arrangement that may be used in an eCig. When step up is needed, the MCU applies PWM to the boost circuit (Figure 1, to IN of the DGD2104A) and the output voltage (to buck) is higher than the battery voltage. When step down is needed, the Q1 is on 100% duty cycle providing the battery voltage to the buck (not shown) and the MCU provides PWM to the buck.

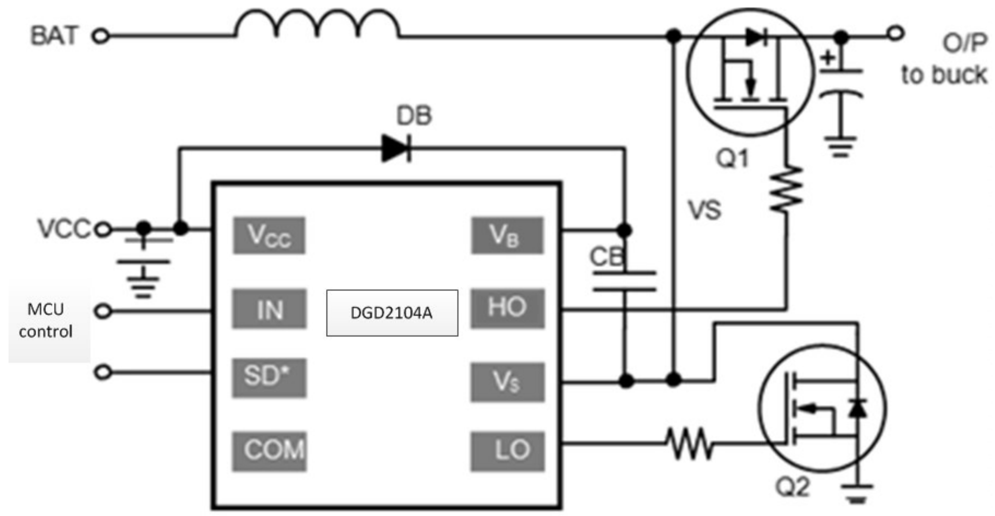

Figure 1: Typical Boost Schematic for eCig Driver

Gate Driver Performance and UVLO

Figure 1 shows a typical synchronous boost arrangement that could be used in an eCig application. Considering Figure 1, when Q1 is on at 100% duty cycle, V_S is at battery voltage; the Li-ion battery in an eCig is 3.7V typical (min of 3.2V and max 4.2V). That means V_S = 3.7V typically when the Q1 is on in the 100% duty cycle state (and even at start up).V_{BS} is the supply for the high side driver for DGD2104A (Figure 1). To improve the safety of the full system during a fault condition or unexpected power down, many Diode's Gate Driver ICs have V_{BS} UVLO (Under Voltage Lock Out). The DGD2104A has a V_{BS} UVLO+ (positive going threshold) of 8.9V typical and a V_{BS} UVLO- (negative going threshold) of 8.2V typical.

Increasing Vcc

In the 100% duty state, V_{BS} is supplied by V_{CC} through the boot strap diode (DB) or a MOSFET. Hence to function in this type of circuit, V_{CC} must be at a level to maintain the optimal supply conditions for the high side. The suggested value of V_{CC} can be calculated as follows:

$$V_{CC} = (V_{BS}\ \text{UVLO+}) + (\text{VD}) + (\text{BAT (max)})$$

Where VD is the voltage drop of the bootstrap diode, and BAT (max) is maximum value of the Li-ion battery.

As an example, considering the V_{BS} UVLO+ = 8.9V of the DGD2104A, and BAT (max) = 4.2V and VD = 0.6V, you would require a V_{CC} = 13.7V. Hence for eCig applications, with requirements like those above, we recommend a V_{CC} = 14V. If a Schottky diode or a MOSFET are used in the V_{CC} bootstrap line, then there would be a smaller voltage drop, and a lower V_{CC} could be used in the application. Best selection of V_{CC} will be determined by the application and part selection.