

## 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.

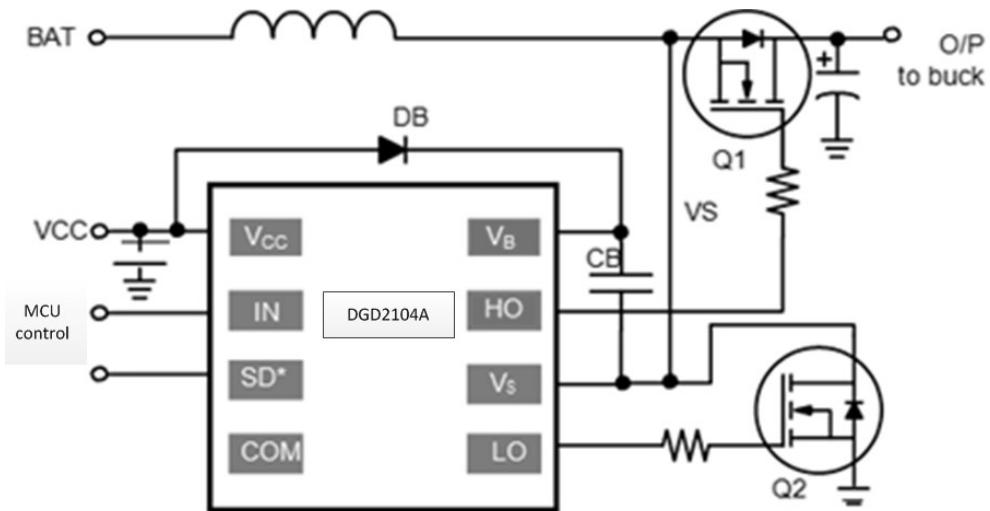


Figure 1: Typical Boost Schematic for eCig Driver

### 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<sub>S</sub> 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<sub>S</sub> = 3.7V typically when the Q1 is on in the 100% duty cycle state (and even at start up). V<sub>BS</sub> 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 Diodes' Gate Driver ICs have V<sub>BS</sub> UVLO (Under Voltage Lock Out). The DGD2104A has a V<sub>BS</sub> UVLO+ (positive going threshold) of 8.9V typical and a V<sub>BS</sub> UVLO- (negative going threshold) of 8.2V typical.

### Increasing V<sub>CC</sub>

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

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

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.

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