Motor control

In order to control the speed of the motors, one of the potential options would be to use an H-bridge to control the DC motors. However, that seemed unecessary, as another lighter and less power-consuming option would be to one N-channel mosfet for each motor.

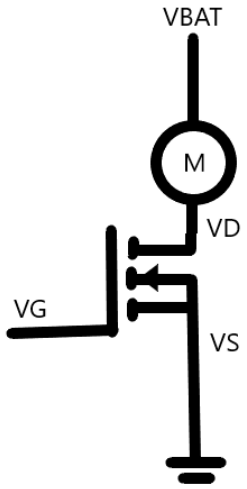

Figure 1: Motor control with MOSFET.

As illustrated in figure 1, the drain of the MOSFET is connected to the Motor, which is supplied by the battery and the source of the MOSFET is grounded. Meanwhile, the VG pins are connected to one of the PWM pins of the nRF52840 MCU, where the opening of the gate is proportional to the PWM. Thus, when VG (simulated by PWM) is smaller than the V threshold of the MOSFET, the motors are static, and if VG surpasses V threshold, then the motors start spinning with higher RPM as PWM is increased. The MOSFETs used for this situation are FDD8896 [2], as it has a low threshold voltage of 2.5V (MCU pins can supply up to 3.3V), and can handle up 94A in continuous drain current.

MCU Overcurrent Protection

In the process of building a quadcopter drone, one of the things needed to be configured was protection against overcurrent being drawn from the microcontroller. When the motors are switched on or off, a surge current arises which can result in additional overcurrent being pulled from the microcontroller if the battery is not alone capable of supplying the current.

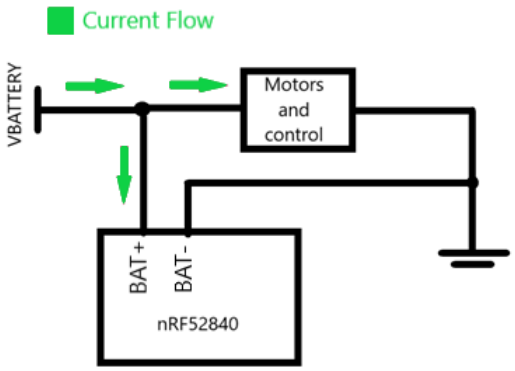

Figure 2: Current flow during continuous operation.

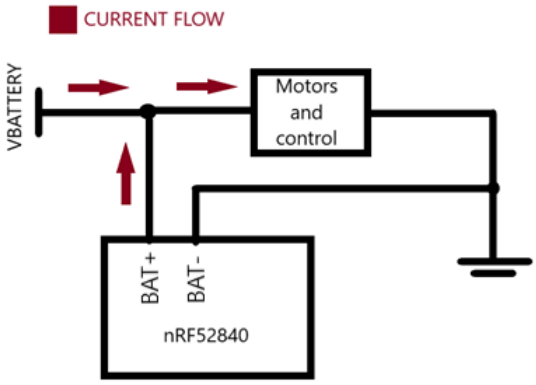

Figure 3: Potential current flow due to surge current.

In order to prevent reverse current from the MCU, during a surge, one of

the potential options to utilise would be a diode placed in the following configuration.

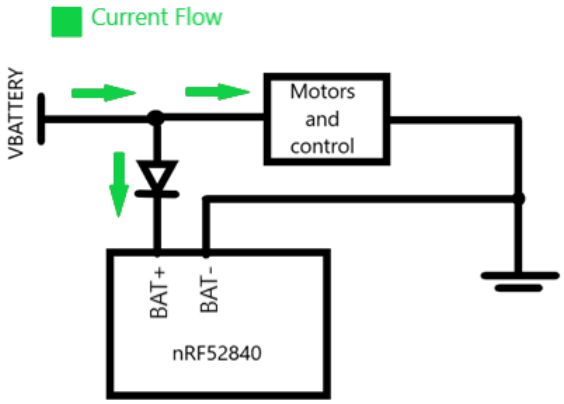

Figure 4: Diode added to prevent reverse current flow from MCU.

Additionally decoupling capacitors were added in parallel to the positive and negative motor pins and the MCU BAT+ and BAT- pins.

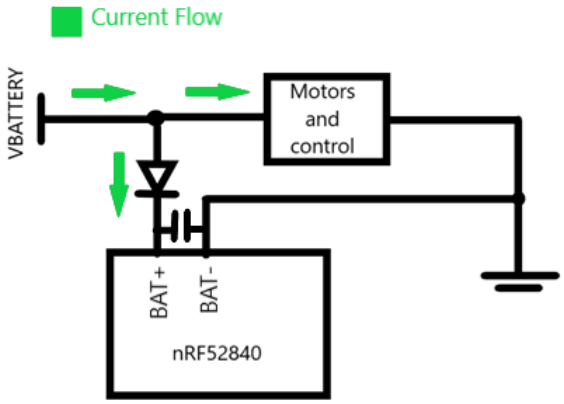

Figure 5: Example of decoupling capacitor for stable voltage to MCU.

The diode utilised is 1N5818 [3], as it has a low forward voltage of under 0.5V, resulting in low power losses. Moreover, the decoupling capacitors are

cermaic capacitors as they generally smaller in size, and they are rated at 100 nF, which follows the general guidelines of decoupling capacitor values. [1]

References

[1] Autodesk what are decoupling capacitors? https://www.autodesk.com/products/fusion-360/blog/what-are-decoupling-capacitors/.

[2] Fairchild Semiconductor fdd8896 datasheet. https://pdf1.alldatasheet.com/datasheet-pdf/view/85382/FAIRCHILD/FDD8896.html.

[3] Motorola 1n5818 datasheet. https://pdf1.alldatasheet.com/datasheet-pdf/view/2817/MOTOROLA/1N5818.html.