14. Implementation of Driver Circuit for Magnetotorquers

1 Task Definition

The group task for course 31368 two week project period is:

- Design a suitable driver circuit with the following guide lines(proposal supplied by the current DTUsat ACDS team, figure 1):
  - Power consumption below 5mW when disabled.
  - Switching loss below 10% at normal operation (3.3V supply voltage and 32kHz PWM frequency).
  - Loading of the signal sources below 1mA.
  - Final implementation with SMD components for all three axes may only utilise 25mm by 35mm PCB area on a four layer PCB.
- Construction of prototype and testing:
  - Functionality verification.
  - Measurement of power consumption, switching loss, upper frequency limit, usable temperature range, usable voltage range.
- Documentation (report) in english, handed in according to the course requirements and as PDF file upload to the DTUsat home page.

2 Specifications and Requirements

The DTUsat utilises three magnetotorquers as attitude actuators, and these are driven by three PWM signals and a common enable signal. Signal levels are 0V/3.3V directly from a microprocessor.

Supply voltage for the magnetotorquers are unregulated battery voltage ranging from 2V to 6V. Normal operation voltage is expected to be app. 3.3V. Magnetotorquers must be fully operational from 3V to 6V. Below 3V no short circuit or other unnecessary loading of the supply may occur.

Current design of the magnetotorquers are 475 turns with a AWG17 copper wire (app. $10.5 \cdot 10^{-9}$ m^2 bare copper area). Turns are placed in a coil form with 65mm by 65mm inner dimensions and a length of 2.5mm. For normal operation this should yield a current ripple of app. 10% of full load current with a 32kHz PWM signal.

3 Remarks

Some remarks from the current ACDS team:

- The proposed design may have some problems with the high switch frequency.
- MOSFETs Si4963 and Si4966 have been tested for radiation hardness and are thus preferred.
- Investigate the need for additional diodes parallel with the H-bridge transistors.

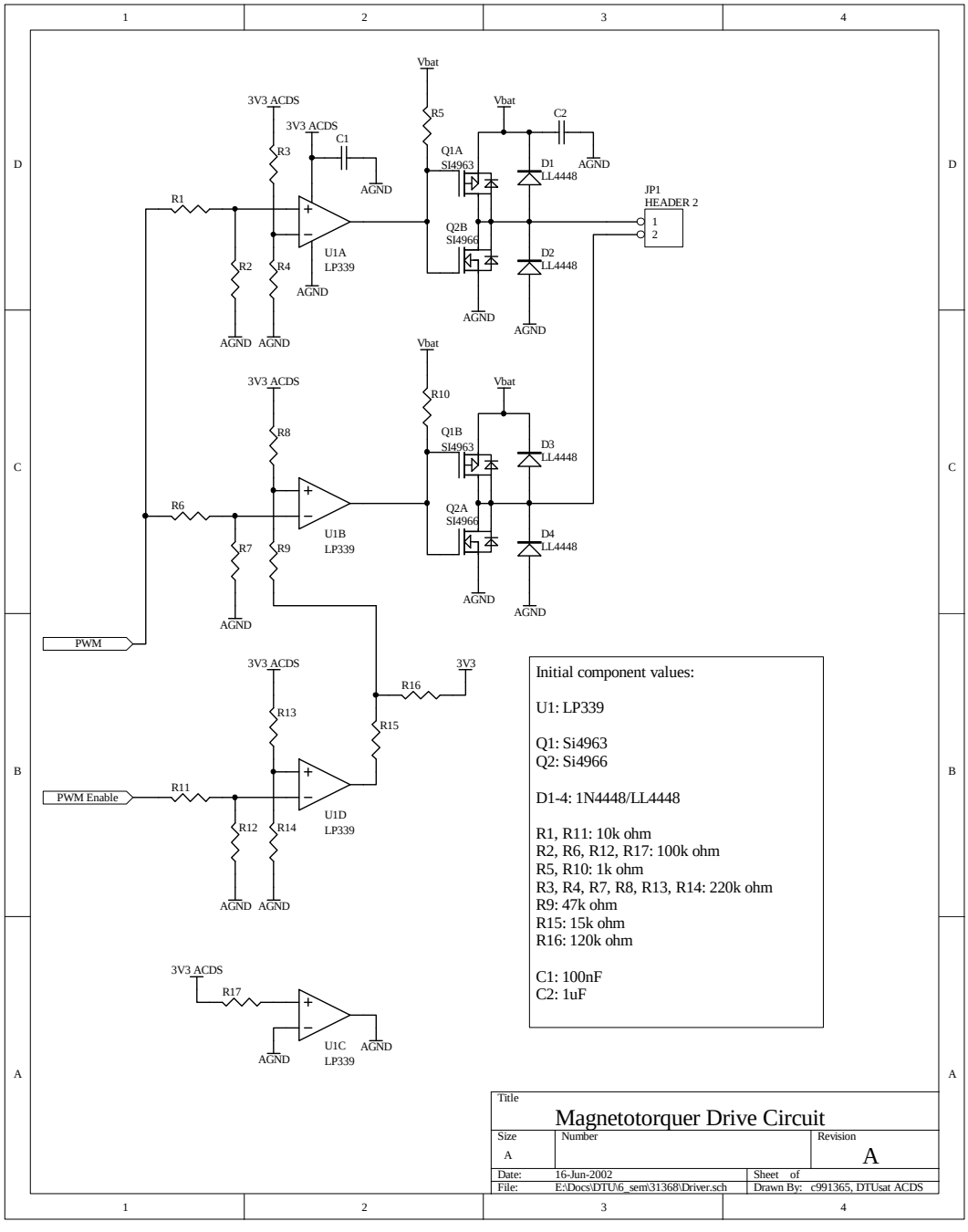

Figure 1: Proposal for driver circuit.