Test of Current Measurement on Viking's Race Car

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16-12-2024

Contents

1 Introduction

This experiment will test the current measurement functionality on the master controller.

2 Setup and Execution of the Experiment

The experiment is carried out by measuring the current consumed by the master controller. This current measured on the ammeter is compared to the value measured by the master controller itself.

2.1 Equipment

The list below shows the equipment used:

- Keysight 34410A digital multimeter
- EA-PS 5080-20A power supply
- Master controller
- Computer to read the current reading from the ADC

2.2 Execution

The setup of the experiment is shown in fig. 1.

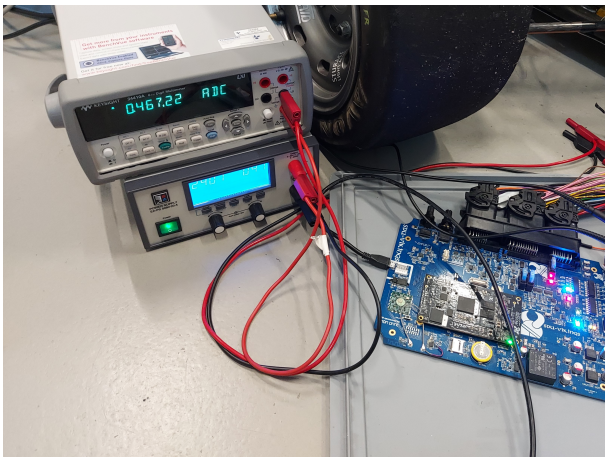

Figure 1: Experiment setup

3 Data Collection & Results

3.1 Data Collection

Since the master controller in this experiment uses a constant current, the current used is shown in fig. 2.

3.2 Results

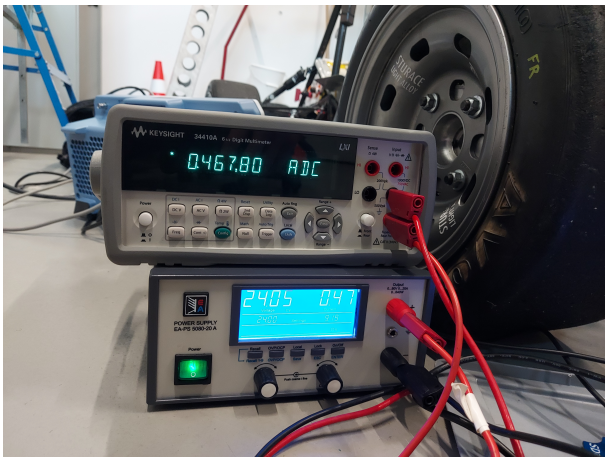

Figure 2: Current used by master controller

The results from the ADC are shown below:

```
Elapsed time: 0.5 seconds
LVS Current ADC value: 167.
LVS Current before division: 0.040537 V.
LVS Current after division: 0.203497 V.

Elapsed time: 2.0 seconds
precharging state
LVS Current ADC value: 166.
LVS Current before division: 0.041270 V.
LVS Current after division: 0.207175 V.

Elapsed time: 4.5 seconds
precharging state
LVS Current ADC value: 170.
LVS Current before division: 0.041514 V.
LVS Current after division: 0.208400 V.

Elapsed time: 7.0 seconds
precharging state
LVS Current ADC value: 170.
LVS Current before division: 0.041758 V.
LVS Current after division: 0.209626 V.

Elapsed time: 9.5 seconds
precharging state
LVS Current ADC value: 171.
LVS Current before division: 0.042002 V.
LVS Current after division: 0.210852 V.

Elapsed time: 12.0 seconds
```

```
drive state
PS_allive_task
LVS Current ADC value: 169.
LVS Current before division: 0.041758 V.
LVS Current after division: 0.209626 V.

Elapsed time: 14.0 seconds
drive state
LVS Current ADC value: 169.
LVS Current before division: 0.041270 V.
LVS Current after division: 0.207175 V.
```

By comparing the current shown in fig. 2 and the measurements above, it is clear that the currents do not add up. This error is significant and needs to be investigated in the future.

3.3 Possible Error Sources

There are a couple of reasons why the results are as they are. The first is to consider the voltage division in fig. 3. The voltage division here is done to make sure the signal can fit the 1 V range the ADC has. It is a possibility that there is an error in the way the program calculates the voltage that represents the current.

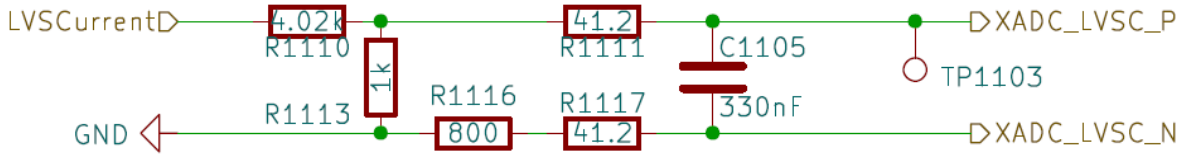

Figure 3: Voltage division on the input to the ADC.

Another possible issue is that the IC used for measuring the current isn't calibrated to a satisfactory state. The way current is measured is shown in fig. 4. The IC requires calibration, and it is not done at the master controller. Furthermore, the shunt is very small, which ensures a small voltage across the resistor. This is on purpose, but it might also be the error source since the small voltage has to be detected. Take a look at the `LVS Current before division` lines in the result. The voltage here is close to the actual value but a factor of 10 off. A solution could be to tweak the op-amp so that the value is correct and then fix the factor of 10 by multiplying by 10.

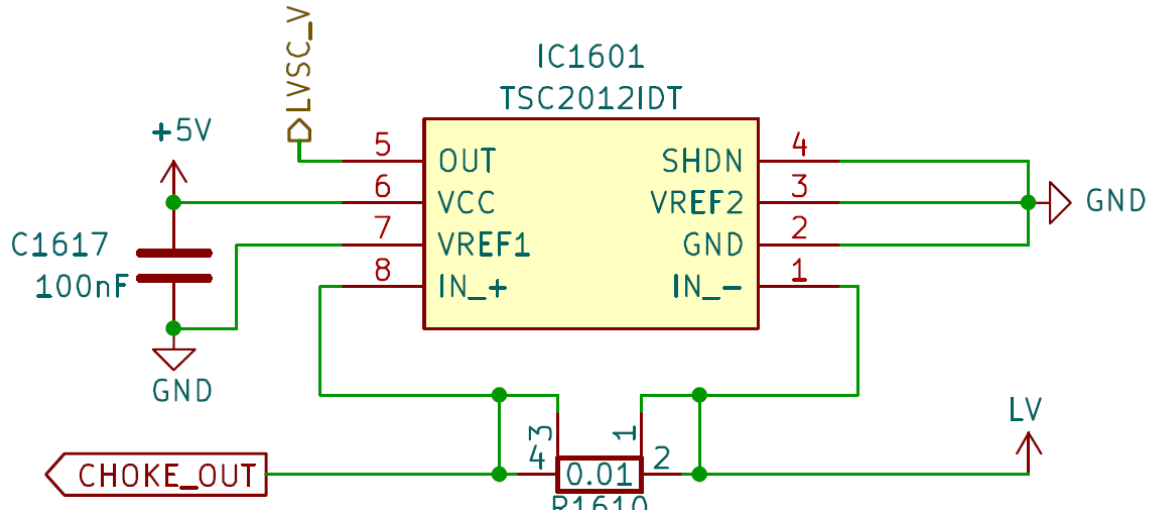

Figure 4: Voltage division on the input to the ADC.

4 Discussion

The discrepancies between the measured current values and the expected values indicate potential issues in the measurement setup. The voltage division circuit and the calibration of the current measurement IC are critical areas to investigate. Ensuring accurate voltage division and proper calibration of the IC can significantly improve the accuracy of the current measurements. Additionally, the small shunt resistor, while designed to minimize impact, may introduce errors if not properly accounted for in the measurement calculations.

5 Conclusion

The experiment highlighted significant discrepancies between the measured and expected current values. These discrepancies suggest issues with the voltage division circuit and the calibration of the current measurement IC. Future work should focus on refining the voltage division calculations and ensuring proper calibration of the measurement IC. Addressing these issues will improve the accuracy of current measurements on the master controller.