Why design a High Efficiency Power Supply System for Micromouse with Vacuum

Present by: Green Ye

Introduction

Classic 4 Wheeler



Tetra, 2009 Kato Yusuke 2010 2012 2013 All-Japan 1st place





Brabham BT46 1978, F1

Vacuum Design Robotracer



Source of pictures: Online Banned in All-Japan after 2011 for safety reason No restriction at any other places

Recent



Saiden, 2012 Utsunomiya Masakazu

Latest Trends 2014 All-Japan 2015 All Japan **2015 APEC 2016 APEC** 2015 Taiwan

Source of pictures: Online

Introduction



Why Vaccum??? Pros

Inside pressure < Outside pressure

Adding down force

f = uN



Power
Weight
Complexity

Why do we need to design a more efficient power system?



Need more power Fan Power More wheel motor power **Limited Space** • Limited Battery Size Limited PCB Space Thermo LDO Heats • IR Heats

Past Design

2 cell Lipo battery

5V LDO Regulator

Encoder, Display IR Emitter

Motor Driver

Motors



LC Filter IR Receiver Gyro

Past Design

GND LM2940 5V OUTPUT BAT INPUT GND **5V LDO** 25 •Simple C_VBAT3 C_VBAT4 C 5V 1 C_5V_2 T 0.1uF 100uF 0.1uF •Bulky 100uF Inefficient GND

Past Design

How much power has been wasted? Average Battery Power 8V •5V LDO output: 5V •Percent wastage: (8-5) / 8 = 37.5% ! Max current usage: 50-700mah •Power wastage: 700mah X 3V = 2.1W ! (peak)

IR Emitter(IR LED)

Switching pulsing
Simple
Current limiting resistor



IR Emitter Problem

Pulsing high current
Voltage Divider
Power waste



- Resistor: 5-1.8=3.2V
- Power waste: 3.2V X 0.5A = 1.6W
- Efficiency: 1.8V/5V=36%



CH347

That is A LOT of power waste!

How do we fix this?

There is only one viable solution

That's DC-DC technology!!

Efficient 5V system

LMZ21701 3x3mm package Only 8 pins











Efficient IR Driving Circuit

Lower voltage
Lower resistance
Lower current



LMZ10501 (2V)



LMZ10501 Configure



Figure 12. Typical Application Circuit



Figure 20. Efficiency V_{OUT} = 1.8 V

New efficiency

- 333mah current
- 1.75V Voltage drop
- 0.25V on resistor
- IR Efficiency:

now:

1.75V / 2V = 87.5%! before: 36%





Efficient Fan Power Supply

- Vin: 12V (3 cell lipo)
- Vout: 3-4V
- Current: 3A Max







Efficient?

Efficiency vs Output Current



Overall Looking for New Power System



Challenges

• Noise

- Low-Pass Filter
- More Caps
- Isolate paths
- Space limit
 - More power IC
 - radiation
 - make more space

Demo Video

