模块 5

讲解：电池和电压调节

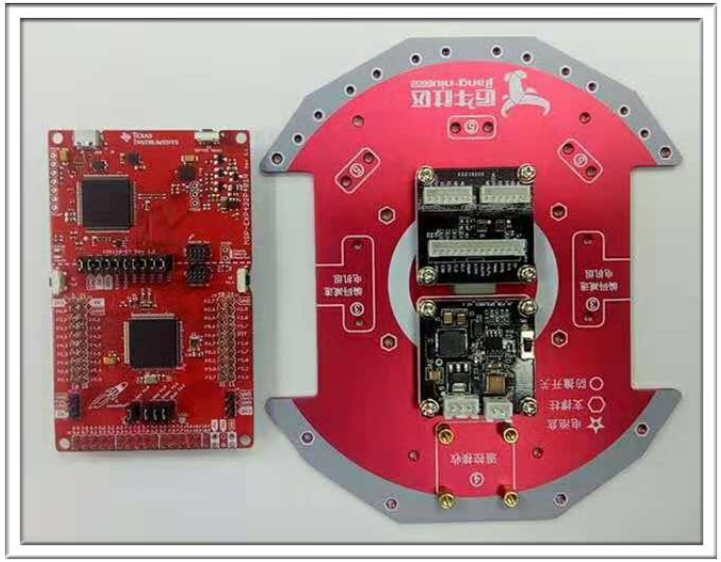
电池和电压调节

在本模块中您将学会：

- 电源 – 电池
  - 电压，V (伏特)
  - 电流，I (安培)
  - 功率，E (焦耳)

- 电压调节（恒压）
  - 目的
  - 型号
  - 电路

- 性能测量（实验）
  - 监测电池电压，电流，存储
  - 电压调节（直流电压表）
  - 噪声（交流电压表，示波器）



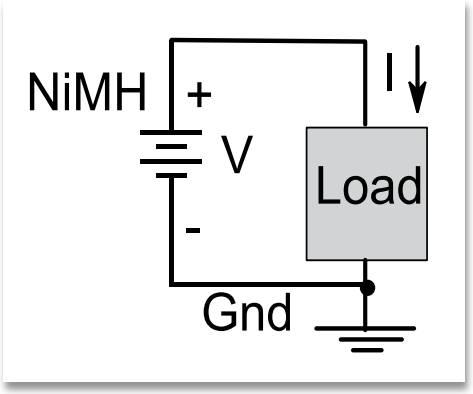
电机驱动器和供电板为 TI Launchpad 开发板供电

功率和能量

功率来源

- 120/220 VAC（交流） 50/60 Hz
  - 需要AC到DC转换器
  - 需要一个稳压器
- 直流电源（USB上+ 5V，汽车上使用+ 12V）
  - 用于为TI的Launchpad（5V）供电的USB电源
- 电池
  - 需要自动驾驶机器人
  - 给TI的Launchpad，电机，传感器供电
  - 电压，能量，大小，重量
  - 需要稳压器以获得**恒定电压**
- 能量收集就像太阳能或电磁场一样收取

Power = V*I (watts)
Energy = V*I*time (Joules)



功率预算

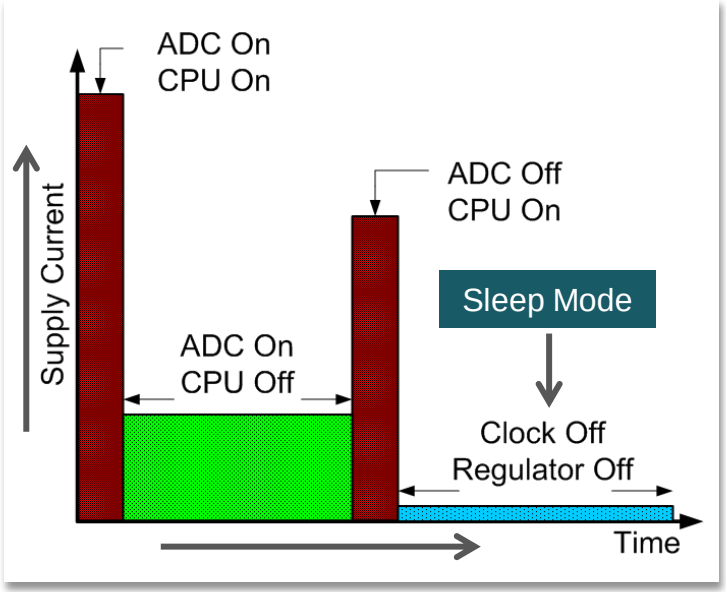
Energy = V*I*time
Storage = I*time (amp-hr)

电池供电的嵌入式系统

- 功率预算=>电池寿命
  平均电流<储能/寿命

- 节能：
  降低电压，睡眠模式，时钟，CPU，

TI Launchpad MSP432 低功耗MCU



MSP432：在不同模式下供电

电池

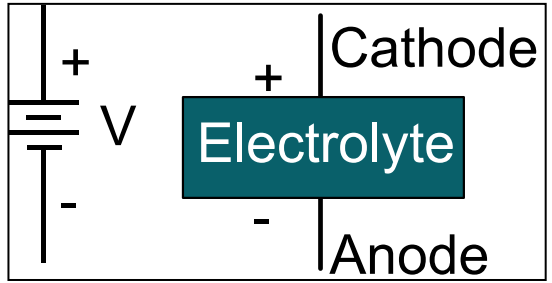
电池的类型

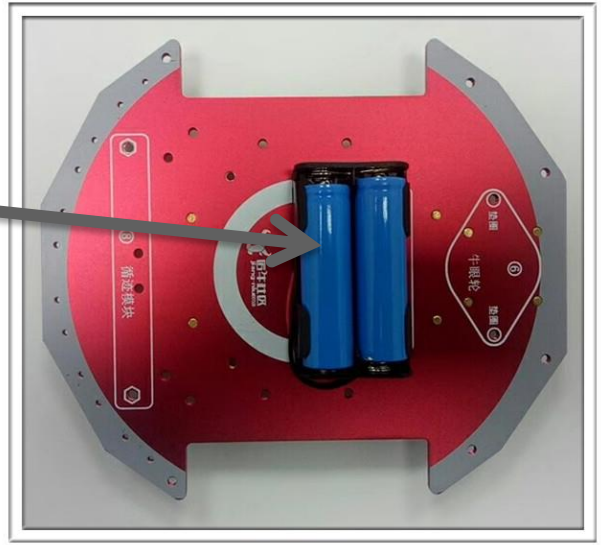
- 不可充电
  - 重型电池（Heavy duty）
  - 碱性电池（Alkaline）
  - 铅酸电池（Lead-acid）
  - 锂电池（Lithium）

- 可充电的
  - 镍镉电池（NiCad）
  - 镍氢电池（NiMH）
  - 锂离子电池（Li-ion）
  - 超级电容（Supercap）

Energy = V*I*time
Storage = I*time (amp-hr)

Battery内部





电池

AA型电池

Energy Storage = V*I*time
= I*time (amp-hr)

电池	电压 (V)	容量 (Ah)	类型
碱性电池	1.5	2	不可充电
锂电池	1.5	3	不可充电
镍镉电池	1.2	1.2	可充电
镍氢电池	1.2	1.8	可充电
锂离子电池	3.6	1.9	可充电

大多数能量用于相同尺寸的电池

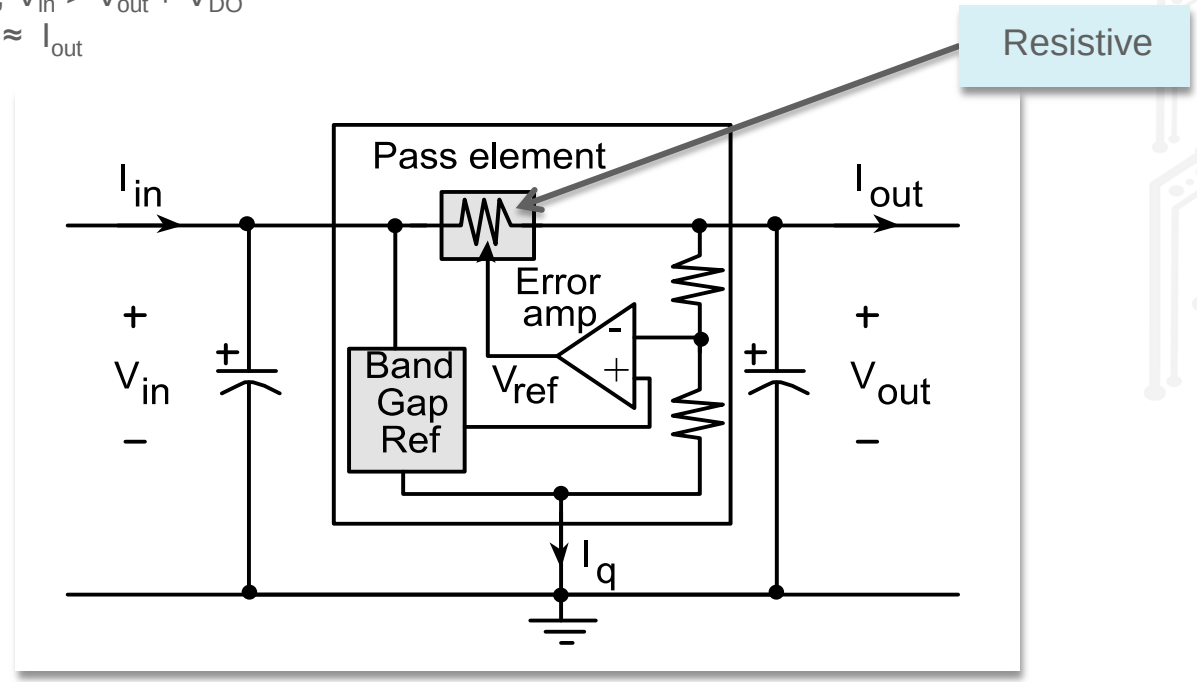
以0.5A运行，您的机器人将运行3.6小时

t_{life} = Energy Storage/ I
= 1.8/0.5 = 3.6 hr (NiMH)

使用线性稳压器进行电压调节

性能

- 产生恒定的输出电压Vout，用于改变输入电压Vin和负载Iout
- Dropout voltage（压差电压），$V_{in} > V_{out} + V_{DO}$
- 效率低（耗散更多功率），$I_{in} \approx I_{out}$
- 低噪声



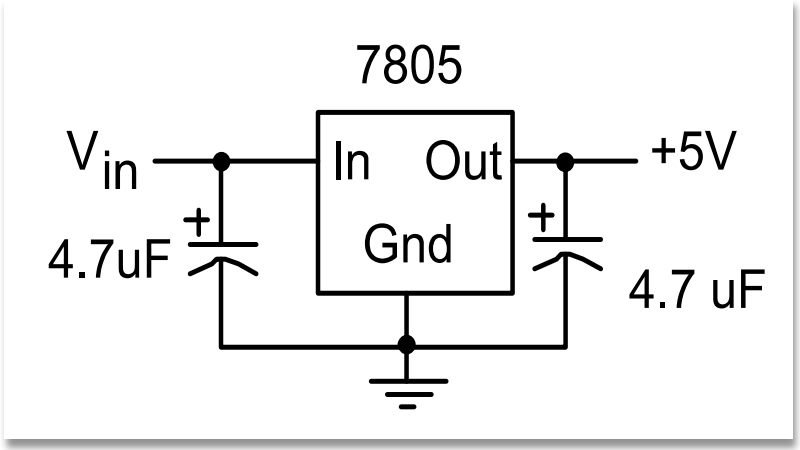
输入功率 – 输出功率= 7.2 V X 100 mA - 5 V X 100 mA = 0.22W功率损耗！

使用线性稳压器进行电压调节

示例 + 5V稳压器

参数：

- V_{in} > 7V (V_{DO} = 2V)
- I_{out} < 1 amp



如果您没有匠牛的电机驱动器供电板，请自行搭建此电路 。

WEBENCH®是德州仪器（TI）的免费设计工具，您可以使用它来设计电源电路吗？
http://www.ti.com.cn/zh-cn/tools-software/design-center/webench-power-designer.html

使用开关稳压器进行电压调节

性能

- Buck：降压（Vin > Vout）
- Boost：升压（Vin < Vout）
- Buck-boost：降压-升压
- 开关噪声

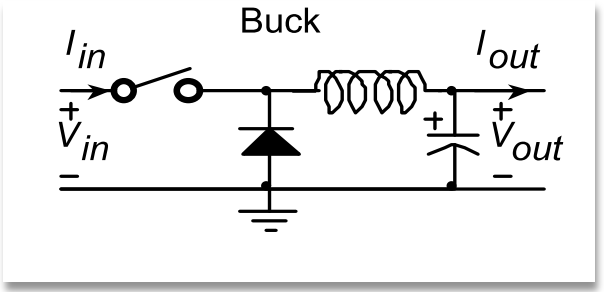
Power In ≈ Power Out

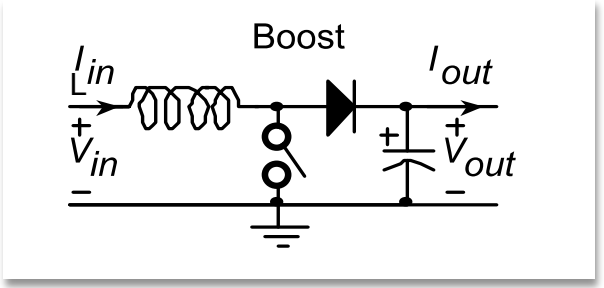
$V_{in} * I_{in} \approx V_{out} * I_{out}$

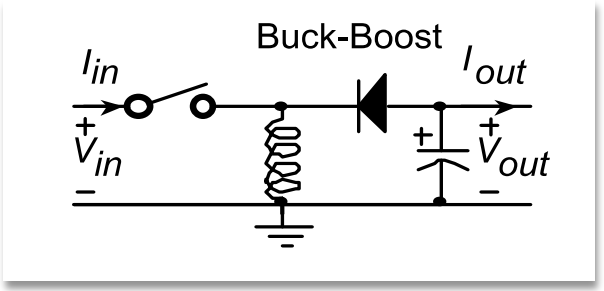
Efficiency = $(V_{out} * I_{out})/(V_{in} * I_{in})$

Or P_{out} / P_{in}

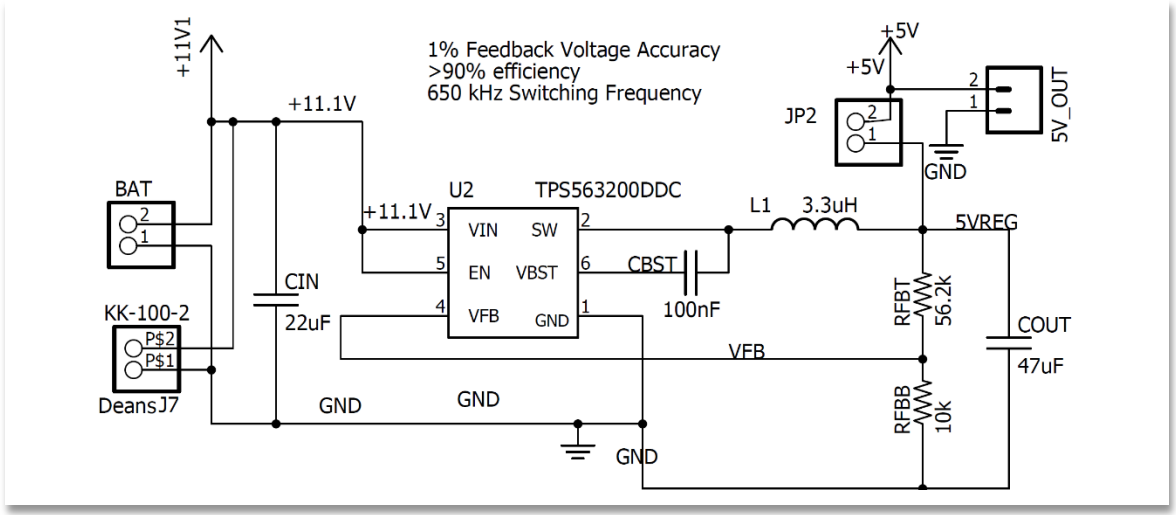
要了解有关稳压器的更多信息，请访 ti.com/PMLK



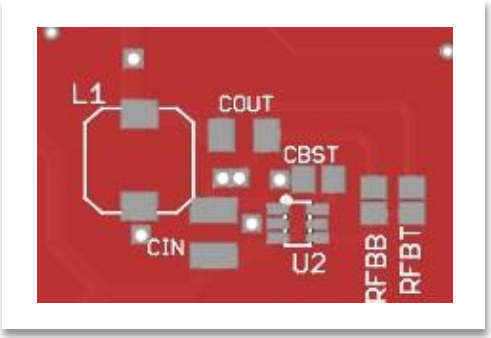




开关稳压器电路：一个例子



警告：
注意不要将稳压器输出端的导线连接到地。!!



采用TI TPS563200 17V输入，2 A同步降压稳压器的开关稳压器的原理图和PCB

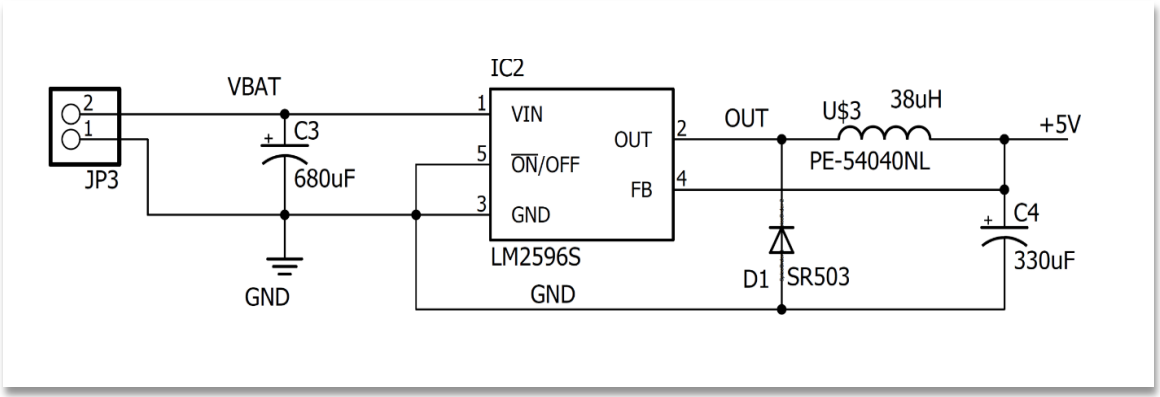
电机驱动器和配电板（来自实验）使用类似的调节器

开关稳压器电路：一个例子

- 3.3V，5V，12V和可调输出版本
- 降压（降压）开关稳压器
- 提供TO-220和TO-263封装
- 确保负载电流输出3A的版本
- 仅需要4个外部组件
- 150 kHz固定频率内部振荡器
- 高效率
- 热关断
  和限流保护

TO-220-5 package

这些功能提供电路保护

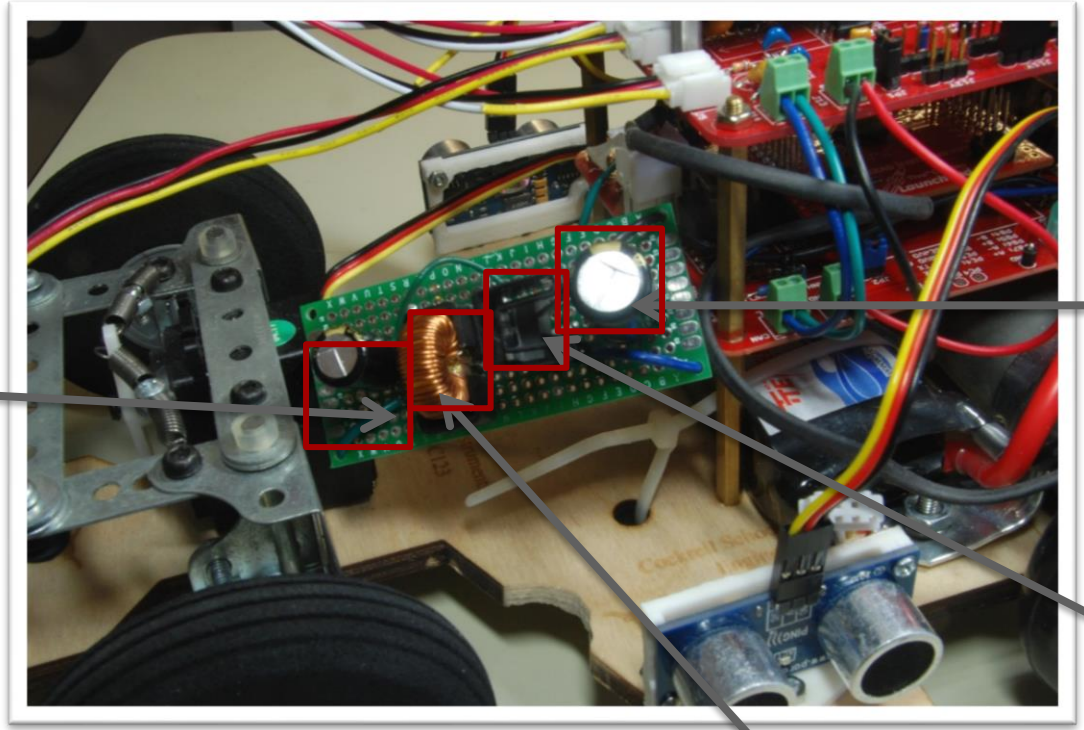


如果您没有匠牛的电机驱动器配电板或使用7805，请构建此电路。有关电源设计的更多信息，请访问 http://www.ti.com/tool/lm2596s-adjevm

采用TI LM2596的开关稳压器电路板

- LM2596T-5.0
- 所有通孔部件
- 已验证电路

如果您没有匠牛的电机驱动器配电板，请构建此电路。



电池和电压调节

总结

- 电源 - 电池
  - 可充电和不可充电
  - 功率预算和电池容量
- 电压调节 - 线性稳压器
  - 低噪声
  - 耗散功率 = $(V_{in}-V_{out})*I_{out}$
  - 压差，$V_{in} > V_{out}+V_{do}$
- 电压调节 - 开关稳压器
  - 更大的压降
  - 可升压
  - 高效率

Power = V*I
Energy = V*I*time
Energy Storage = I*time
Power Budget:
Average Current < Energy Storage/t_{life}

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