TI-RSLK MAX

Texas Instruments Robotics System Learning Kit

Texas Instruments

Module 5

Introduction: Building the robot

Introduction: Building the robot

Educational Objectives:

MEASURE Voltage, current, and energy for a battery
UNDERSTAND Voltage regulation for the robot
BUILD The circuits needed to power the robot from batteries

Prerequisites (Module 2)

- Voltage, current, energy, power (Module 2)
- Resistance, capacitance (Module 2)

Recommended reading materials for students:

- Chapter 5, **Embedded Systems: Introduction to Robotics**, Jonathan W. Valvano, ISBN: 9781074544300, copyright © 2019

Every embedded system needs power to operate. The source of power could be
- 120 VAC 60 Hz, with an AC to DC converter
- DC power, like +5V on USB or +12V in an automobile
- Batteries
- Energy harvesting like solar or EM field pickup

When debugging the LaunchPad, you use +5V from the PC via the USB cable. However, to run the robot autonomously, it will need battery power. The battery voltage is not constant; it decreases with age and use. Therefore, you will use a **regulator** to provide a constant voltage to power most of the electronics for the robot. In this module, we will introduce two types of regulators: linear and switching. There are many considerations when choosing a regulator, and we will discuss some of these considerations.

You will power the robot motors directly off the battery voltage. The TI-RSLK MAX robot chassis can hold 6 AA batteries. You can use rechargeable NiMH batteries (1.2V each), this will create a +7.2V source for the robot. The motors do not need a constant voltage to operate, and running directly off the batteries is the most efficient use of energy. As you might imagine, the motors use most of the power required by the robot. The robot will take the battery +7.2V input and create a +5V and 3.3V regulated power sources. In particular, you will use the RSLK interface board shown in Figure 1. We will explain the battery and voltage regulation in this module. You will connect the +3.3V regulated power source to the MSP432 on the LaunchPad. The MSP432 itself has regulators inside the chip. For example, V_{CORE} is the internal voltage at which the processor operates, and it is typically +1.2V. You will power the motors directly off the battery, some of the external devices with +5V and others with +3.3V.

The **energy** (E in joules) stored in a battery can be calculated from voltage (V in volts), current (I in amps), and time (t in seconds). Energy has neither polarity nor direction. The energy rating for the battery is given in amp-hr, because the assumption is the voltage is constant. The NiMH batteries listed in the lab bill of materials (BOM) are rated at 1900 mA-hr. This means the battery can supply 1 amp for 1.9 hours. Six of these batteries, placed in series, can supply 7.2V at 1 amp for 1.9 hours.

In the lab associated with this module, see Figure 1, you will study the batteries, measuring their energy storage. Next, you will connect the circuits needed to power the Robot off batteries. Lastly, you will learn about the TI-RSLK Chassis board and how to build and test the robot.

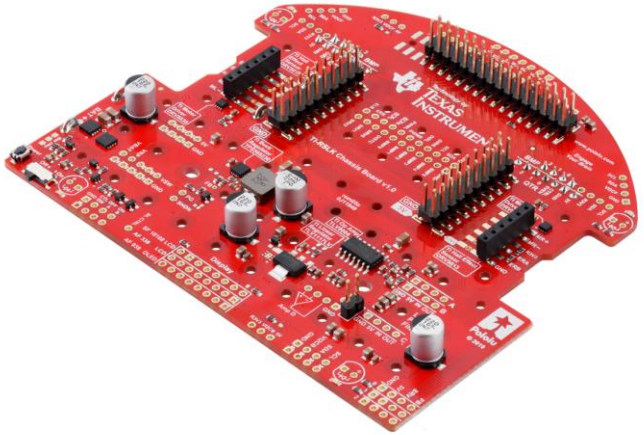

Figure 1. TI-RSLK Chassis board (www.pololu.com).

ti.com/rslk

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